New

National Universities Commission

Core Curriculum and Minimum Academic Standards for the Nigerian University System (CCMAS)

Engineering/ Technology

2022

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Executive Secretary: Abubakar Adamu Rasheed

This publication can be referenced as: *Core Curriculum and Minimum Academic Standards (CCMAS) for Nigerian Universities*

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Foreword

In furtherance of the "change" mantra of the present administration, I published a roadmap to guide my Ministry on ways of addressing the multiple problems that faced the education sector of the country shortly after my assumption of office in 2016. Known as "***Education for Change: Ministerial Strategic Plan – 2016-2019"*** (updated to 2018-2022), the content of the document reaffirms government's commitment to strengthening institutional structures and establishing innovative approaches that would quickly revamp the education sector.

The nations' universities hold a pride of place in the execution of such a strategy, being at the peak of the educational system and charged in an overall manner, with the responsibility of catalysing the sustainable and inclusive growth and prosperity that the "change" mantra envisions. Thus, a "rapid revitalization of the Nigerian university system", which is proceeding apace, became imperative. Improvement in research, teaching and learning facilities, deepening ICT penetration and the provision of enhanced power supply in our university campuses are some of the areas receiving stringent attention. In the same vein, the need was felt to radically review the curricula which universities had used for more than a decade so as to put in place one that would more directly address local issues, meet international standards and is fit for purpose for the training of 21st century graduates.

The National Universities Commission has concluded the review of the former *Benchmark Minimum Academic Standards (BMAS)* of 14 disciplines into those of Core *Curriculum and Minimum Academic Standards (CCMAS)* of 17 disciplines. I am therefore pleased to present these documents to the universities, the general public and the international community as I am sure that their application would tremendously uplift scholarship in our universities. I thank all and sundry who worked assiduously to bring this seminal enterprise to fruition.

Malam Adamu Adamu
Honourable Minister of Education

Preface

Section 10 (1) of the Education (National Minimum Standards and Establishment of Institutions) Act, Cap E3, Laws of the Federation of Nigeria 2004, empowers the National Universities Commission to lay down minimum standards for all universities and other degree awarding institutions of higher learning in the Federation and the accreditation of their degrees and other academic awards. The earliest efforts at giving effect to this legal framework in the Nigerian University System (NUS) started in 1989 following the collaboration between the Commission and Nigerian Universities, which led to the development of the Minimum Academic Standards (MAS) for all programmes in Nigerian universities. The MAS documents were subsequently approved by the Federal Government for use as a major instrument for quality assurance in the Nigerian University System (NUS). The documents were employed in the accreditation of programmes in the NUS for over a decade.

In 2001, the Commission initiated a process to revise the documents because the said MAS documents were essentially content-based and merely prescriptive. In 2004, the Commission developed outcome-based benchmark statements for all the programmes through a workshop that allowed for exhaustive deliberations by relevant stakeholders. Following comments and feedback from the universities to the effect that the Benchmark-style Statements were too sketchy to meaningfully guide the development of curriculum and inadequate for the purpose of accreditation, the Commission, in 2007 put in place a mechanism for the merger of the Benchmark-style Statements and the revised Minimum Academic Standards, which birthed the Benchmark Minimum Academic Standards (BMAS). The resultant BMAS, an amalgam of the outcome-based Benchmark statements and the content-based MAS clearly articulated the Learning Outcomes and competencies expected of graduates of each academic programme in Nigerian Universities without being overly prescriptive while at the same time providing the requisite flexibility and innovativeness consistent with institutional autonomy. In all, the BMAS documents were developed for the thirteen existing disciplines namely, **Administration and Management, Agriculture, Arts, Basic Medical Sciences, Education, Engineering and Technology, Environmental Sciences, Law, Medicine and Dentistry, Pharmaceutical Science, Sciences, Social Sciences and Veterinary Medicine.**

The Commission, in 2016, in its sustained commitment to make the NUS adaptable to global trends in higher education, constituted a group of relevant academic experts to develop a BMAS in **Computing**, thus increasing the number of disciplines in Nigerian Universities to fourteen.

In keeping with its mandate of making university education in Nigeria more responsive to the needs of the society, the National Universities Commission commenced the journey to restructure the BMAS in 2018, introducing in its place, the **Core Curriculum and Minimum Academic Standards (CCMAS),** to reflect the 21st Century realities, in the existing and new disciplines and programmes in the Nigerian University System.

The new CCMAS is a product of sustained stakeholder interactions over two years. The composition of each panel took into consideration, the triple helix model, as a unique feature. This involved a blend of academic experts, academies, government (represented by NUC), professional bodies and of course, the private sector represented by the Nigerian Economic Summit Group (NESG). In order to enrich the draft documents, copies of each discipline were forwarded to all critical stakeholders including the relevant academic units in

Nigerian Universities, the private sector, professional bodies and the academies for their comments and input. These inputs along with the curriculum of programmes obtained from some foreign and renowned universities served as major working materials for the various panels constituted for that purpose.

Bearing in mind the need to adhere to covid-19 protocol as prescribed by the National Centre for Disease Control (NCDC), the Commission was compelled by prevailing circumstances to finalize the curriculum virtually. General Assemblies were also held via Zoom, comprising, the NUC Strategic Advisory Committee (STRADVCOM), Chairpersons/Co-Chairpersons of the various disciplines and Panel Members of the respective programmes. Each Discipline and Programme had NUC representatives who assisted panellists with all the tools and working materials. Several online meetings were held at programmes level, where the real business of developing the CCMAS took place. The products of the various programme-based virtual meetings were submitted to the corresponding discipline group and then to the National Universities Commission. These documents were further scrutinized and fine-tuned by a smaller group of versatile subject matter specialists and relevant private sector practitioners.

In line with the dynamism in higher education provisioning, the Commission took cognizance of complaints by the universities on the high number of General Studies (GST) courses in the BMAS, and was subsequently streamlined. Entrepreneurship courses such as Venture Creation and Entrepreneurship, and innovation found generous space. In addition, the new curriculum unbundled the Bachelor of Agriculture, Bachelor of Science in Mass Communication and the Bachelor of Architecture Programmes, while establishing some emerging specializations in these fields as obtained globally. This is in furtherance of the goal of producing fit for purpose graduates. The Allied Health Sciences was also carved out as a new Discipline from the existing Basic Medical Sciences discipline.

Preceding the completion of the curriculum review content and language editing, a 3-day validation workshop (face-to-face mode) involving critical stakeholders, including STRADVCOM, Vice-Chancellors and Directors of Academic Planning of Nigerian Universities, as well as the Nigerian Economic Summit Group (NESG) was organized by the Commission to validate the CCMAS documents, and to engender ownership for ease of implementation.

Consequent upon the afore-mentioned processes, seventeen CCMAS documents were produced for the following academic disciplines in the NUS:

1. Administration and Management
2. Agriculture
3. Allied Health Sciences
4. Architecture
5. Arts
6. Basic Medical Sciences
7. Computing
8. Communication and Media Studies
9. Education
10. Engineering and Technology
11. Environmental Sciences
12. Law
13. Medicine and Dentistry
14. Pharmaceutical Science
15. Sciences

16. Social Sciences
17. Veterinary Medicine

The CCMAS documents are uniquely structured to provide for 70% of core courses for each programme, while allowing universities to utilise the remaining 30% for other innovative courses in their peculiar areas of focus. In addition to the overall Learning Outcomes for each discipline, there are also Learning Outcomes for each programme and course. In general, programmes are typically structured such that a student does not carry less than 30 credit units or more than 48 credit units per session.

Consequently, the Commission is optimistic that the 2022 CCMAS documents will serve as a guide to Nigerian Universities in the design of curriculum for their programmes with regards to the minimum acceptable standards of input and process, as well as, measurable benchmark of knowledge, 21st century skills and competences expected to be acquired by an average graduate of each of the academic programmes, for self, national and global relevance.

Professor Abubakar Adamu Rasheed, *mni, MFR, FNAL, HLR*
Executive Secretary

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Introduction

Two Acts provide the legal framework for the quality assurance and regulatory mandates of the National Universities Commission. The first is the **National Universities Commission Act No. N81 Laws of Federation Nigeria (L.F.N.) 2011**.

> *This Act sets up the National Universities Commission as a body corporate charged with the responsibility of advising the Federal and State Governments of all aspects of university education and the general development of universities in Nigeria*.

The second, **Education (National Minimum Standard and Establishment of Institutions) Act No. E3 L.F.N. 2004**,

> *empowers the National Universities Commission to lay down minimum standards for all universities and other institutions of higher learning in the Federation and the accreditation of their degrees and other academic awards in formal consultation with the universities for that purpose, after obtaining prior approval therefor through the Minister, from the President.*

Following the enactment of NUC Act No. E3 L.F.N. 2004, the National Universities Commission developed the first set of Minimum Academic Standards (MAS) in 1989 for all the academic programmes existing in the Nigerian University System (NUS) at that time under the 13 major disciplines of Administration, Agriculture, Arts, Education, Engineering and Technology, Environmental Sciences, Law, Medicine and Dentistry, Management Sciences, Pharmaceutical Sciences, Sciences, Social Sciences and Veterinary Medicine. The Minimum Academic Standard served as the reference documents for the first accreditation of programmes conducted in NUS in 1990.

In its bid to review the Minimum Academic Standard documents, which was predicated on the fact that they were prescriptive, the Commission decided to develop the outcome-based Benchmark Statements for all programmes in the Nigerian University System in line with contemporary global practice in 1999. In the first comprehensive review of the Minimum Academic Standards by NUC, which was in 2004, the Commission decided to merge the Benchmark Statements and the revised Minimum Academic Standards into a new document called Benchmark Minimum Academic Standards (BMAS). These documents were approved for use in Nigerian universities in 2007. A second attempt at reviewing the BMAS was in 2011. It must however be noted that stand alone BMAS for new programmes were at different times developed by the Commission on request from some Nigerian universities.

The Current Review of the BMAS

The journey of the current curriculum review efforts commenced in 2018, when the National Universities Commission circulated the 2018 draft BMAS to all Nigerian universities and other stakeholders for their comments. In addition to the harvested comments, the curriculum of different programmes of some world-class universities were downloaded. The draft 2018 BMAS, compiled comments of Nigerian universities and other stakeholders and the downloaded curriculum of some foreign universities served as the working documents for the curriculum review panels.

A multi-stakeholder approach was deployed in constituting the panels for the curriculum review exercise. The constituted panels included:

a. academic staff of Nigerian universities;
b. representatives of the Academies;
c. representatives of Professional bodies/associations; and
d. representatives of the private sector.

In addition to the reviewers working individually and in consultation with their subject area peers, over 512 cumulative online meetings of the general assembly (Vice-Chancellors, Discipline Chairmen/Chairpersons, programme-specific reviewers and Heads/representatives of international quality assurance agencies and institutions); Discipline groups; and programme groups were held between March and November, 2021. Physical meetings were also held to finalise the curriculum review exercise.

The reviewers carried out their assignments with a view to producing a curriculum for their respective programmes that will reflect both national and international expectations. Specifically, the reviewers focused on ensuring that the emerging curriculum will be adequate to train Nigerian university students in the 21st Century. By implication and in addition to current trends in the various programmatic areas, the curriculum will be ICT oriented, promote Artificial Intelligence, enhance skills acquisition (including soft skills), inculcate and sharpen entrepreneurship mindset of students and capable of steering the deployment of evolving technologies to deliver its content.

The Core Curriculum Minimum Academic Standards (CCMAS)

The major highlights of the new curriculum are:

1. Change of nomenclature from **Benchmarks Minimum Academic Standards (BMAS)** to **Core Curriculum and Minimum Academic Standards (CCMAS)**;

2. The curriculum provides for 70% minimum core courses requirements for graduation. Nigerian universities are expected to provide the remaining 30%;

3. In consonance with global best practice, the curriculum is to stimulate blended learning in its delivery;

4. Mass Communication has been unbundled to create a distinct discipline of Communications comprising degree programmes in Advertising, Broadcasting, Development Communication Studies, Film and
Multimedia, Information and Media Studies, Journalism and Media Studies, Mass Communication, Public Relations and Strategic Communication;

5. Agriculture has been unbundled into programmes in its contributing components of B.Sc Agricultural Economics, B.Sc. Animal Science, B.Sc. Crop Science and B.Sc. Soil Science;

6. The unbundling of Architecture and introduction of Architecture as a new discipline with programmes like Architecture, Architectural Technology, Furniture Design, Interior Architecture Design, Landscape Architecture and Naval architecture;

7. The split of the Basic Medical Sciences discipline into two – Basic Medical Sciences and Allied Health Science;

8. Reduction of the General Studies (GST) course from 36 credit units to 12 credit units of 6 courses as follows:

i. Communication in English;
ii. Nigerian People and Culture;
iii. Philosophy, Logic and Human Existence;
iv. Entrepreneurship and Innovation;
v. Venture creation; and
vi. Peace and Conflict resolution.

9. Entrepreneurship has been repackaged with the introduction of programme-specific entrepreneurship;

10. The number of academic disciplines has been increased from 14 to 17 as follows:

i. Administration and Management
ii. Agriculture
iii. Allied Health Sciences
iv. Architecture
v. Arts
vi. Basic Medical Sciences
vii. Communications and Media Studies
viii. Computing
ix. Education
x. Engineering and Technology
xi. Environmental Sciences
xii. Law
xiii. Medicine and Dentistry
xiv. Pharmacy
xv. Science
xvi. Social Science
xvii. Veterinary Medicine

Having reviewed the curriculum of Nigerian universities, the next steps will include training and retraining of academic staff of Nigerian universities to effectively deliver the content of the curriculum.

Glossary of Course Codes

These are the 3-letter codes for the identification of courses offered in the various programmes in the Engineering and Technology discipline as well as courses offered in other disciplines covered in the CCMAS for the Nigerian University System. They are in three categories dictated by the sources of courses involved:

Category A: Course codes for courses offered in programmes outside the Engineering and Technology Discipline

Category B: Course codes for the general and foundation courses offered by all students registered in the various programmes in the Engineering and Technology Discipline.

Category C: Course codes for courses offered by the various programmes in the Engineering and Technology Discipline.

Category A:

The Programme offering the Courses	Course Code
Chemistry Programme in the Science Discipline	CHM
Mathematics Programme in the Science Discipline	MTH
Physics Programme in the Science Discipline	PHY
Biology Programme in the Science Discipline	BIO
Agriculture Programme in the Agriculture, Forestry, Fisheries and Home Economics Discipline	AGR

Category B:

The Programme offering the Courses	Course Code
General Studies courses offered at the University Level for students registered for GSTs in all the disciplines in the university.	GST
Entrepreneurship courses offered at the University Level for students registered for ENTs in all the disciplines in the university.	ENT
Foundation courses for all the programmes in the Engineering and Technology Discipline	GET

Category C:

The Programme offering the Courses	Course Code
Aerospace Engineering	AAE
Agricultural and Biosystems Engineering	ABE
Automotive Engineering	TAE
Biomedical Engineering/Technology	BME
Chemical Engineering	TCH
Civil Engineering	CEE
Computer Engineering	CPE
Electrical Engineering	TEL
Electrical and Electronics Engineering	EEE
Electronics Engineering	ELE
Environmental Engineering	EVE
Food Science and Technology	FST
Industrial and Production Engineering	IPE
Information and Communication Engineering	ICE
Marine Engineering	MAR
Materials and Metallurgical Engineering	MME
Mechanical Engineering	MEE
Mechatronics Engineering	MCE
Metallurgical Engineering	MTE
Mining Engineering	MNE
Natural Gas Engineering	GNG
Petrochemical Engineering	PCE

Petroleum Engineering	PEE
Petroleum and Gas Engineering	PGE
Structural Engineering	STE
Systems Engineering	SYE
Telecommunications Engineering	TEE
Water Resources Engineering	WRE
Wood Products Engineering	WPE

Preamble

These Core Curriculum Minimum Academic Standards (CCMAS) are designed for the education and training of undergraduate students wishing to obtain first degrees in the different areas of Engineering and Technology in the Nigerian University System. Presented in this Section are the basic operational elements that serve to define the minimum academic standards required to achieve the cardinal goal of producing graduates in Engineering and Technology with sufficient academic background and practical exposure to face the challenges of a developing economy in an increasingly globalised world economy.

It is pertinent to note that this CCMAS Document is expected to guide institutions in the design of curricula for their engineering and technology programmes by stipulating the minimum requirements. Being such, institutions are encouraged to take due cognizance of the CCMAS while bringing necessary innovation into the content and delivery of their programmes towards achieving the overall goals of engineering education and training in the country.

Programmes and Degrees

Presented in Table 1.1 is the list of programmes and the degrees in view covered in the CCMAS Document An attempt has been made to cover not only the programmes being currently run in various Faculties of Engineering and Technology, but, also, proposed new programmes in response to the local and global dynamics of the requisite knowledge and skills of products of engineering and technology. Overall, it is expected to serve the needs of existing faculties contemplating minor or major programme review and also new institutions seeking to chart a new path away from the existing programmes in the system.

Table 1.1: List of Programme(s) and Degree(s) in View

S/N	PROGRAMME	DEGREE(S) IN VIEW
1	Aerospace Engineering	B.Eng./B. Tech./B.Sc.
2	Agricultural and Biosystems Engineering	B.Eng./B. Tech./B.Sc.
3	Automotive Engineering	B.Eng./B. Tech./B.Sc.
4	Biomedical Engineering	B.Eng./B. Tech./B.Sc.
5	Chemical Engineering	B.Eng./B. Tech./B.Sc.
6	Civil Engineering	B.Eng./B. Tech./B.Sc.
7	Computer Engineering	B.Eng./B. Tech./B.Sc.
8	Electrical Engineering	B.Eng./B. Tech./B.Sc.
9	Electrical and Electronic Engineering	B.Eng./B. Tech./B.Sc.
10	Electronic Engineering	B.Eng./B. Tech./B.Sc.
11	Environmental Engineering	B.Eng./B. Tech./B.Sc.
12	Food Science and Engineering/Technology	B.Eng./B. Tech./B.Sc.
13	Industrial and Production Engineering	B.Eng./B. Tech./B.Sc.
14	Information and Communication Engineering	B.Eng./B. Tech./B.Sc.
15	Marine Engineering	B.Eng./B. Tech./B.Sc.
16	Materials and Metallurgical Engineering	B.Eng./B. Tech./B.Sc.
17	Mechanical Engineering	B.Eng./B. Tech./B.Sc.

18	Mechatronics Engineering	B.Eng./B. Tech./B.Sc.
19	Metallurgical Engineering	B.Eng./B. Tech./B.Sc.
20	Mining Engineering	B.Eng./B. Tech./B.Sc.
21	Natural Gas Engineering	B.Eng/B. Tech/B.Sc.
22	Petrochemical Engineering	B.Eng./B. Tech./B.Sc.
23	Petroleum Engineering	B.Eng./B. Tech./B.Sc.
24	Petroleum and Gas Engineering	B.Eng./B. Tech./B.Sc.
25	Structural Engineering	B.Eng./B. Tech./B.Sc.
26	Systems Engineering	B.Eng./B. Tech./B.Sc.
27	Telecommunications Engineering	B.Eng./B. Tech./B.Sc.
28	Water Resources Engineering	B.Eng./B. Tech./B.Sc.
29	Wood Products Engineering	B.Eng./B. Tech./B.Sc.

The above programmes are designed, in general, to be broad-based to equip the graduates with the diverse tools of the profession. However, where it is considered absolutely essential to reflect the various areas of specialization in a programme, such area can be indicated appropriately in the degree title.

Philosophy

The Philosophy and Mission Statement underlying the programmes in Engineering and Technology are aimed at achieving the goals and objectives of the National Policy on Industrialisation and Self-Reliance. This is to be achieved through:

1. broad–based foundation in Engineering and Technology as well as specialized knowledge and practice in a particular discipline therein;
2. practical exposure to application of Engineering and Technology to problem solution;
3. adequate training in human behaviour and organisational management;
4. developing in the students, entrepreneurial knowledge, a sense of public responsibility and a spirit of self-reliance;
5. nurturing of partnership between the institution and industry for effective programme delivery;
6. creating an awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
7. creating an awareness and understanding of the need to develop leadership and team building skills to maximize the benefits of an engineering education and its application to solving problems.

The general philosophy therefore is to produce graduates with high academic and ethical standards and adequate practical exposure for self-employment as well as being of immediate value to industry and the community in general.

Objectives

The general goal and objectives of Engineering and Technology education and training should be in consonance with the realisation of national needs and aspirations vis-à-vis industrial development and technological emancipation. The graduates must therefore be knowledgeable, creative, resourceful and able to perform the following functions:

1. application of the knowledge of mathematics, basic and engineering sciences, and proficiency in using standards, codes, and modern information and communication technology tools in engineering practice;

2. design engineering projects and supervise their implementation;
3. design and implement components, machines, equipment and engineering systems;
4. design and develop new products and production techniques in industries;
5. conceptualise, implement and maintain complex engineering systems for optimal performance in our environment;
6. adapt and adopt exogenous technology in order to solve local engineering problems;
7. ability to consider ethics, the environment and sustainability in the solutions to complex engineering problems;
8. exercise original thought, have good professional judgment and be able to take responsibility for the execution of important tasks;
9. improve on indigenous technology for deployment to the solution of engineering problems; and
10. demonstration of emotional stability, and endowment with critical multidisciplinary and team-work, goal-getting and life survival capabilities and skills, necessary in managing people, funds, materials, equipment and technologies.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in any of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry(DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate Examination (SSCE) in at least five subjects, which must includes English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters;
2. candidates admitted through the Direct Entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters;
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively;
4. a student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the

university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00; and

5. a student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Course System

All Engineering and Technology programmes shall be run on a modularised system, commonly referred to as Course Unit System. All courses are therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credits are weights attached to a course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures or three hours of laboratory/studio/workshop work per week per semester of 15 weeks.

Definition of Course System

This should be understood to mean a quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed. The courses are arranged in levels of academic progress. There shall be five levels of courses numbered 101-199, 201-299, 301-399, 401-499 and 501-599. For ease of identification, course numbers can be prefixed by a three-character programme/subject code. Thus, the course code is in the form: DEP LNJ (where the three-letter code DEP identifies the programme, 'L' in LNJ represents the level of the course (1 or 2 or 3 or 4 or 5 for all undergraduate courses), N represents the sub-subject area while J represent the semester the course is offered some hierarchical code. Thus, for example, MEE 207 is a 200-Level course with number 0 say for labs and 7 indicating 1st semester, offered in the mechanical engineering programme. The glossary of all the course codes are presented earlier under Glossary of Codes.

The second aspect of the system is that courses are assigned weights allied to Units.

Units: Consist of specified number of student-teacher contact hours per week per semester. Units are used in two complementary ways: one, as a measure of course weighting, and the other, as an indicator of student work load:

1. As a measure of course weighting for each unit course e.g. the credit unit to be earned for satisfactorily completing the course is specified; thus a 2-credit unit course may mean two 1-hour lecture per week per semester or one 1-hour lecture plus 3-hour practical per week per semester.
2. As a measure of work load, "One Credit Unit" means one hour of lecture or one hour of tutorial per week per semester. For other forms of teaching requiring student teacher contact, the following equivalents may apply: two hours of seminar: three hours of

laboratory or field work, Clinical practice/practicum, studio practice or stadium sporting activity, six hours of teaching practice; four weeks of industrial attachment where applicable.

Normally, in the Course Credit System, courses are mounted all year round, thus enabling students to participate in examinations in which they are unsuccessful or unable to participate on account of ill health or for other genuine reasons. In such a system, no special provisions are made for re-sit examinations.

The minimum number of credit units for the award of a degree in engineering and technology is 150 units, for a 5-year programme subject to the usual Department and Faculty requirements. A student shall therefore qualify for the award of a degree when he has met the conditions.The minimum and maximum credit load per semester is 15 and 24 credit units respectively.

For the purpose of calculating a student's cumulative GPA (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course. Grades scored at each and all attempts shall be included in the computation of the GPA. Pre - requisite courses must be taken and passed before a particular course at a higher level.

Grading of Courses
Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.2.

Table 1.2: Grade Point System

Mark %	Letter Grade	Grade Point
70 – 100	A	5
60 – 69	B	4
50 – 59	C	3
45 – 49	D	2
40 – 44	E	1
< 40	F	0

Grade Point Average and Cumulative Grade Point Average
For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of Units x Grade Point (TUGP) by the total number of units (TNU) for all the courses taken in the semester as illustrated in Table 1.3.

The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

Table 1.3: Calculation of GPA or CGPA

Course	Units	Grade Point	Unit x Grade Point (UGP)
C_1	U_1	GP_1	U_1 x GP_1
C_2	U_2	GP_2	U_2 x GP_2

-	-	-	-
-	-	-	-
C_i	U_i	GP_i	U_i x GP_i
-	-	-	-
-	-	-	-
C_N	U_N	GP_N	U_N x GP_N
TOTAL	**TNU**		**TUGP**

$$TNU = \sum_{i=1}^{N} U_i \qquad TUGP = \sum_{i=1}^{N} U_i * GP_i \qquad CGPA = \frac{TUGP}{TNU}$$

Degree Classifications

The following regulations shall govern the conditions for the award of an honours degree.

1. Candidates admitted through the UTME mode shall have registered for at least 150 units of courses during the 5-year degree programme.
2. Candidates must have registered and passed all the compulsory courses specified for the programme.

The determination of the class of degree shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme. The CGPA shall be used in the determination of the class of degree as summarized in Table 1.4. It is important to note that the CGPA shall be calculated and expressed correct to two decimal places.

Table 1.4: Degree Classification

Cumulative Grade Point Average (CGPA)	**Class of Degree**
4.50 – 5.00	1st Class Honours
3.50 – 4.49	2nd Class Honours (Upper Division)
2.40 – 3.49	2nd Class Honours (Lower Division)
1.50 – 2.39	3rd Class Honours
1.00 - 1.49	Pass

Students who transfer from other departments/programmes or universities shall be credited with only those courses deemed relevant to the programmes, which they have already passed prior to their transfer. Such students shall however be required to pass the minimum number of units specified for graduation for the number of sessions he/she has spent in the Faculty; provided that no student shall spend less than two sessions (4 semesters) in order to earn a degree. Students who transfer from another programme in the Faculty or other faculties for any approved reason shall be credited with those units passed that are within the curriculum of the programme to which he/she has transferred. Appropriate decisions on transfer cases shall be subjected to the approval of Senate on the recommendation of the Faculty.

Probation

A student whose Cumulative Grade Point Average is below 1.00 at the end of a particular year of study, earns a period of probation for one academic session. A student on probation is allowed to register for courses at the next higher level in addition to his/her probation level courses provided that:

1. the regulation in respect of student work-load is complied with; and
2. the pre-requisite courses for the higher-level courses have been passed.

Withdrawal

A candidate whose Cumulative Grade Point Average is below 1.0 at the end of a particular year of probation should be required to withdraw from the programme. However, in order to minimize waste of human resources, consideration should be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

Evaluation

Techniques of Student Assessment

Practicals

By the nature of the programmes in Engineering and Technology, laboratory practicals are very important in the training of students. To reflect the importance of practical work, a minimum of 9 hours per week or 135 hours per semester (equivalent to 3 units) should be spent on students' laboratory practical's. Consequently, some of the courses have both theory and practical components. Thus, in the description of courses to be taken in any programme, as presented in Sections 2 and 3, the number of lecture hours (LH) and the number of practical hours (PH) per semester are indicated. The overall performance of students in such courses is to be based on the evaluation of the performance in written examination (which tests theory) and also the performance in the laboratory work (based on actual conduct of experiments and the reports).

The experiments to achieve the practical's components of the courses must be designed in quality and quantity to enrich the grasp of the theoretical foundations of the courses. It is left for the department to organize all the experiments in the best way possible. One of the ways to achieve this is to lump all the laboratory practical's under a course, which the student must pass.

Tutorials

The timetable for courses shall be designed to make provision for tutorials of at least one hour for every four hours of lecture. Thus a 3-unit course of 45 hours per semester should attract about 10 hours of tutorials. Postgraduate students are normally employed to help in giving tutorials to undergraduate students. This is a veritable training ground for academic career.

Continuous Assessments

Continuous assessment shall be done through essays, tests, and practical exercises.

1. Scores from continuous assessment shall normally constitute 30 per cent of the full marks for courses which are primarily theoretical.
2. For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 40% of the final marks.
3. For courses that are entirely practical, continuous assessment shall be based on a student's practical work or reports and shall constitute 100% of the final marks.

Examinations

In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. All courses shall be graded out of a maximum of 100 marks comprising:

Final Examination: 60% - 70%

Continuous assessment (Quizzes, Homework, Tests, Practical's): 30% - 40%

Each course shall normally be completed and examined at the end of the semester in which it is offered.

External Examiner System

The external examiner system should continue. This system should be used only in the final year of the undergraduate programme to assess final year courses and projects, and to certify the overall performance of the graduating students, as well as the quality of facilities and teaching in the faculty. Furthermore, the existing practice of using different External Examiners for major subject areas in professional programmes, such as Engineering and Technology, should be continued.

SIWES Rating and Assessment

In engineering education, industrial attachment is very crucial. The minimum duration of the Students Industrial Work Experience Scheme (SIWES) should be 45 weeks accomplished in 3 modules.

SIWES I : (3 Units) 9 weeks during long vacation at the end of 200-Level session
SIWES II : (4 Units) 12 weeks during the long vacation at the end of the 300-Level
SIWES III: (8 Units) 24 weeks from second semester of 400-Level to the beginning of the following session.

SIWES is an important aspect of the education and training of engineering students in the universities organised for exposure to some elements of industrial art as articulated below under the Students Industrial Work Experience Scheme (SIWES) and the Technical Support Unit (TSU). This is being emphasised herein in view of the rather poor handling of SIWES, in particular, in most existing faculties of engineering and technology in the country. It should be noted that Industrial Training as a course involves the following: working successfully in the industry or an industrial setting for the specified period; submitting of a Work Report to the Industrial Training Coordinating Centre at the end of the training period; and presentation of seminar on the industrial training experience.

Faculties of Engineering in universities are expected to organise Students Industrial Work Experience Scheme (SIWES) or what most commonly refer to as Industrial Training. Universities are expected to establish a Unit to coordinate SIWES not only for engineering programmes, but also programmes in other faculties that have SIWES component. The SIWES Unit is to shoulder the following responsibilities: soliciting co-operative placements (jobs) in business, industry, government or service agencies depending upon the needs and qualifications of the student, and placing students on such training assignments after analysing the technical contents; need to establish firm strategy to ensure students get placements and options when they cannot get places; coordinating and supervising the co-operative employment of students in such a way that students have the opportunity of learning useful engineering and technological skills on real jobs and under actual working conditions; conducting follow-up activities regarding all placements by checking regularly each student's job performance through company visits and individual student's interview; assembling individual inventory records of students and employers for the purposes of placements and supervision in addition to maintaining functional departmental and personal records and reports; providing necessary advice to students as to the relevance of their chosen field to the industrial requirements of the country; organizing and conducting students' seminars on Work Reports; and Liaison with NUC, ITF, other agencies and industries on student industrial training programme of the University.

All the 15 experiential units of SIWES will be credited towards the overall assessment for graduation/award of the degree. The Grading template for SIWES will be:

SIWES Supervision Continuous Assessment (from Industry)	25%
SIWES Supervision/Log Book Grading (by University Supervisor)	25%
SIWES Comprehensive Report	25%
Seminar: Oral presentation (defense) of SIWES activity	25%

(i) and (ii) will be scored for each SIWES upon completion and the weighted average for each student computed. However, the consolidated report for all industrial experience will be submitted for seminar and assessment at the end of the 400-level SIWES. The overall grade will then be collated with the 400-level CGPA. This scoring system requires hard work, and adequate funding to sustain the interest of lecturers and industry supervisors, whose capacity must also be enhanced through industry and reverse immersion programmes respectively.

The Committee of Deans of Engineering and Technology (CODET) is assigned the statutory role of leading the coordination and mobilization of resources, infrastructure and the triple-helix partnership for ensuring effective SIWES, while all engineering and technology departments prioritize SIWES assignments with utmost dedication. The triple-helix partnership will involve the following MDAs and Stakeholders: (i) Federal Ministry of Education, (ii) Federal Ministry of Science and Technology, (iii) Federal Ministry of Investment, Trade and Industry, (iv) Federal Ministry of Finance and FIRS, (v) Industrial Training Fund (ITF), (vi) NUC, (vii) NBTE, (viii) TETFund, (ix) COREN and NSE, (x) Nigerian Content Board, (xi) SMEDAN, (xii) MAN, (xiii) NESG, (xiv) Chambers of Commerce and Industry, (xv) Vice Chancellors and Councils of Universities, (xvi) Committee of Vice Chancellors (CVC) and Pro-chancellors (CPC), and others as the prevailing context demands.

Reverse Exchange Programmes

There will be well organized and remunerated industry immersion exchange programmes for university staff during the vacations and industrial training periods. Similarly, there must be a reverse immersion period for industry staff, as academic associates/senior associates engaged in teaching and practical assignments in universities. CODET to propose appropriate funding guidance for this scheme. CODET should also collate and document innovations and other Intellectual Property Products (IPPs) that emerge from these novel initiatives.

Industrial Parks and Tech Incubation Centers

Universities that offer engineering and technology courses are encouraged to establish Industrial Parks, Innovation hubs and Tech Incubation Centers. The Federal Government and relevant MDAs should facilitate the establishment of 6 regional Industrial Parks and Tech Incubation Centres to be located in partnership with a university in each of the 6 geo-political zones for a start and ultimately in each state. These parks shall be, to a large extent, private sector driven and only facilitated by government to limit bureaucracy. Government should provide detailed incentives for companies that establish within the

Industrial Parks and Tech Incubation Centres, such as tax rebate, tax moratorium for a few years of establishment and operation.

Performance Evaluation Criteria

The accreditation of the Engineering and Technology degree programme means a system of recognising educational institutions (universities and programmes offered by them) for a level of performance, integrity and quality which entitles them to the confidence of the educational and professional community, the public they serve, and employers of labour and services.

The objectives of the accreditation exercise are to:

1. ensure that at least the provisions of the minimum academic benchmark statements are attained, maintained and enhanced;
2. assure employers and other members of the community that graduates of these institutions have attained an acceptable level of competence in their areas of specialisation; and
3. certify to the international community that the programmes offered in these universities are of high standards and that their graduates are adequate for employment and for further studies.

B.Eng. Aerospace Engineering

Overview

The Aerospace Engineering curriculum provides a strong fundamental background in Science, Technology, Engineering and Mathematics (STEM) along with the ability to apply this fundamental knowledge to the analysis and design of future air- and space-craft. Aerospace engineering curriculum spills into other tangential areas such as delivery of medical equipment and medication to remote and often undulating landscapes. As far as Nigeria is concerned, there is a need to invest in Aerospace industries for manufacturing of aircraft standard parts with knowledge of software engineering and artificial intelligence.

Aerospace engineering also prepares students for lifelong learning and the attainment of their career goals in the field of aerospace engineering and in a wide range of other areas where the students can later man our Aerospace industries maintaining both quality, standards and the ethics of the industry. By the necessity of the industry, there is a need to introduce the concepts of system design early in the curriculum that will culminate in the yearlong senior capstone design experience in some of the specific courses offered, in which students work in teams to respond to a design challenge from industry, government, or a professional engineering society. We suggest a total of 20 hours of technical and free electives which will allow students pursue an individualized program of study be embarked upon.

Philosophy

The philosophy of the programme is to produce graduates with high academic standards and adequate practical background who can contribute to the development and expansion of Nigeria's economy in aerospace and associated spin-off industries.

Objectives

The main objectives of the programme are to:

1. train and make graduates of the programme functional in the aerospace engineering industry;
2. provide a broad-based training in aeronautical/astronautical engineering such that the products of the program can perform effectively in design, analysis and project management areas of the industry;
3. produce graduates that can easily be upgraded through postgraduate training to undertake teaching and research in institutions of higher learning and undertake consulting services in all aspects of the aeronautical and astronautical industries;
4. be capable of developing and contributing to a sound aerospace industry in Nigeria; and
5. generate knowledge into new technological possibilities through research and development in order to improve technical services to the aerospace and automobile industries.

Employability Skills

Graduates of Aerospace Engineering have several career industry-path options open to them such as: Aircraft production and design; robotics and mechanical engineering; mechatronics, rocket and missile designs; unmanned aerial vehicles (UAV); drones; air and space-based telecommunication, aircraft maintenance; aviation management; research industries which Nigeria must engage in; military service and other related technology-intensive fields.

21st Century Skills

Aerospace in the present 21st century gets into communication and IT, functioning in the metrological world, be comfortable in both civil and defense industries; capable of development of skills necessary to improve the economy of scale, leading to nation building and advancement of global economy. In addition to the basic scientific, engineering and professional skills acquired, the aerospace engineer trained under this programme must have and be able to apply 21st century skills such as:

1. problem-solving;
2. critical thinking;
3. leadership ability required for supervision of mechanical and aerospace projects;
4. high professional and ethical standards;
5. deep understanding of the social, political, and economic realities of different cultures, countries, and indigenous peoples where he is going to function as the aerospace is global;
6. ability to work effectively in interdisciplinary teams;
7. development and use of software packages for acquisition, interpreting and presenting aviation related data, creating 3-D model of a full aircraft, missiles and rockets and be able to participate in space related experiments; and
8. consulting expertise in services of global status in all specialisations of aerospace engineering.

Unique Features of the Programme

This programme compares very well in content to similar programmes in other universities around the world, some of which have been running Aerospace Engineering programme for over a century and are top-ranking among institutions for higher learning worldwide. However, unlike the programmes of some of those institutions which present partial knowledge in favour of narrower specialisation of the profession, this curriculum presents a holistic body of knowledge of the profession (the extractive industry) and yet allows for focus toward specialisation and development of 21st century skills. NUC has refocused aerospace to practical application instead of wholly theoretical, as it should. Thus, this new approach to aerospace engineering will lead to products of this bachelor programme to fit competently into any area of the aerospace engineering profession upon graduation.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must includes English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and

Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Year	GST/ENT	Basic Science	GET Courses	AAE Courses	SIWES Courses	Total
100	4	16	3	2	-	25
200	4	-	20	4	3	31
300	4	-	18	0	4	26
400	-	-		0	8	08
500	-	-	5	10	-	15
Total	**12**	**16**	**47**	**15**	**15***	**105**

* All SIWES courses are credited for GPA computation in the 2nd Semester of the 400 Level

100 Level

Course Code	Course Title	Units	Status	LH	PH

GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Cultures	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
AAE 101	Introduction to Aerospace Engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamental of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
AAE 201	Introduction to Aerospace Systems Engineering II	2	C	15	45
AAE 202	MATLAB Application to Aerospace Engineering	2	C	30	-
AAE 204	Aircraft Flight Principle/Flight Mechanics	2	E	30	-
*GET 299	SIWES I : Students Industrial Work Experience I	3	C	9 weeks	
	Total	**31**			

* SIWES credited in 2nd Semeter of 400 Level; E - Elective

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-

GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence & Machine Learning and Convergent Technologies	3	C	45	-
AAE 301	Aircraft Structural Materials and Fracture	2	E	30	-
AAE 302	Aerospace Technology Lab II	2	E	15	45
*GET 399	SIWES II: Students Work Experience Scheme (12 Weeks)	4	C	12 weeks	
	Total	**26**			

400 Level

Course Code	Course Title	Unit	Status	LH	PH
AAE 401	Aircraft/Spacecraft Conceptual Design (Group Project)	2	E	30	-
AAE 403	Computer Aided Design and Manufacturing	2	E	30	-
AAE 405	Aircraft/Rocket Propulsion Technology	3	E	45	-
AAE 407	Aerodynamics Experiment Methods, Instrumentation and Propulsion Lab	2	E	-	90
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 weeks	
Total		**9**			

SIWES Courses*

GET 299	SIWES I: SWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

* All credited in the 2nd Sememter of 400 Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
AAE 501	Aircraft/Spacecraft Design	2	C	-	90
AAE 503	Aerodynamics of V/STOL Aircraft	3	C	45	
AAE 504	Aircraft Maintenance Management	2	C	15	45
AAE 505	Computational Fluid Mechanics and Mass Transfer I	3	C	45	
	Total	**15**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing(brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using Le Chatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;

7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;

6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II(Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

AAE 101: Introduction to Aerospace Engineering (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. use and incorporate fundamental principles from mathematics, basic science and physics, and computer science to solve general fundamental problems associated with the broad field of aerospace systems;
2. appreciate the various interconnected and interrelated disciplines of the aeronautic or space track within the department;
3. apply the fundamental principles and concepts of engineering to formulate one or more approaches or models to a new problem and to suggest solutions or solution procedures to solve the problem; and
4. communicate knowledge and understanding in written reports and oral presentations.

Course Contents

This course introduces new Aerospace Engineering students to the field of AE and to the curriculum. An overview of aerospace engineering from a design perspective. Job role for maintenance staff. Training opportunities and job progression. Introductory aerodynamics, lift, drag and the standard atmosphere. Aircraft performance. History of aviation, meteorology and astronomy.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge; and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodizing; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, X-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;

4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity.

Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 UnitsC: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student’s major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

AAE 201: Introduction to Aerospace Systems Engineering (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. Design and conducts experiment;
2. Analyse and interpret data;
3. design system, component or process to meet needs;
4. function on multi-disciplinary systems design teams;
5. identify, formulate and solve aerospace engineering problems;
6. demonstrate understanding of the priciples of aircraft performance, stability, control, propulsion and rocket/spacecraft trajectories and orbits; and
7. employ techniques, skills and tools in aerospace engineering practice.

Course Contents

Overview of aerospace engineering from a design and systems perspective. Introductory aerodynamics, lift, drag and the standard atmosphere. Aircraft performance, stability and control. Propulsion. Structures. Rocket and spacecraft trajectories and orbits.

AAE 202: MATLAB Applications to Aerospace Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. use MATLAB as a calculator both for scalars and matrices;
2. use elementary functions and define variables, and construct simple scripts and functions;
3. use control structures (if-statements, for- and while-loops) in simple examples;
4. visualise the results of computations and data sets by self-explaining graphics; and
5. use the help system to learn new functions.

Course Contents

The name MATLAB is an acronym for MATrix LABoratory. MATLAB was written originally to provide easy access to matrix software developed by the LINPACK (linear system package) and EISPACK (Eigen system package) projects. MATLAB integrates computation, visualisation, programing environment and it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. These factors make MATLAB an excellent tool for teaching and research. MATLAB has many advantages compared to conventional computer languages such as C, FORTRAN which are employed for solving technical problems. It is also an interactive system whose basic data element is an array that does not require dimensioning. Engineering students in our universities can use the software package as a standard tool to meet the 21st century industry worldwide needs. Students will use MATLAB's powerful built-in routines that are cable of enabling a very wide variety of computations and easy-to-use graphic commands capable of making the visualisation of results immediately available. Students need to be conversant with the toolboxes required for signal processing, symbolic computation, control theory, simulation, optimisation and several other fields of applied science and engineering.

AAE 204: Aircraft Flight Principle/Flight Mechanics (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss kinematics and dynamics of a 3D rigid body;
2. formulate and provide numerical solution of flight dynamics equations of motion;
3. explain the concepts of static and dynamic stability of aerospace systems;
4. locate of the elastic axis vs aerodynamic center;
5. explain the concepts of divergence and stability with a single DOF model;
6. highlight sweep effects;
7. explain the concept of flutter with a pitch/plunge model; and
8. manage relevant applications to aerospace systems.

Course Contents

An introduction to airplane flight mechanics. Airframe anatomy. Engine anatomy. Equations of motion. Trajectory analysis. Stability and control. Aircraft sizing and simulation. 3DOF equations of motion: Assumptions and coordinate systems; kinematic equations; dynamic equations; weight equation; discussion of 3DOF equations; quasi-steady flight; three-dimensional flight; flight over a spherical earth; and flight in a moving atmosphere. Atmosphere: standard atmosphere and exponential atmosphere.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes and others. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders and others). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and

collaborative groups..

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the student should be able to:
1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and

communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles and many others. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;

6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – such as their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

AAE 301: Aircraft Structural Materials and Fracture (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. demonstrate knowledge of modern aerospace structural materials and their selection for various aircraft components;
2. exhibit ability to use engineering science tools such as advanced mathematics and stress analysis;
3. show ability to perform stress and deformation analysis on common structural forms found on aerospace structures;
4. demonstrate knowledge of failure criteria for engineering materials; and
5. ahow ability to design simple aerospace structures to support mechanical loads.

Course Contents

General concepts of stress and strain. One, two- and three-dimensional stress and strain. Elastic deformation of metals: principles of stresses and strains in metals. Complex stresses on two planes at right angles. Mohr's circle. Principal stresses and strains. Maximum shear stresses. Distortion energy and yield criteria. Application of Mohr's circle for analysis of stress and strain. Tensor analysis of stresses and strains. Tensile response of materials; simple tensile and shear structures.Introduction to mechanical properties of materials commonly used in the aircraft structures, materials failure and structure inspections. Properties of aluminum alloys, titanium steels, composite materials, fractures, fatigues, corrosions and NDT. At the end of the course, students are expected to have basic knowledge on choosing materials for aircraft structures.

AAE 302: Aerospace Technology Lab II (2 Units E: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to function and set up the following laboratories:
1. Computational aerodynamic;
2. Aircraft stability and control;
3. Aircraft systems;
4. Aircraft structures;

5. Fluid mechanic and combustion; and
6. Strength of materials.

Course Contents
Experiments in measurement systems, aerodynamics, aerospace structures, dynamics and control, propulsion, cockpit layout, flight simulator, technical report writing and presentations.

GET 399: Students Industrial Work Experience Scheme II(4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, IBM SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

400 Level

AAE 401: Aircraft / Spacecraft Conceptual Design I (Group Project) (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate good understanding of aircraft design and the role of knowledge-based engineering, so that a good overall picture is obtained and a sound engineering approach to developing new designs linked to industrial operations is developed, through experience of a realistic design project.

Course Contents

Introduction to the principles and techniques of aircraft design. Design methodology. Preliminary design: Problem definition; information retrieval; aircraft requirements; configuration options; initial baseline sizing; baseline evaluation; refining the initial layout; refined baseline design; parametric and trade studies; final baseline configuration and type specification. Case studies. Prerequisite(s) or Concurrent(s): AAE 321, AAE 312, AAE 351 or consent of instructor.

AAE 403: Computer Aided Design and Manufacturing (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. take active role in product design and development process as well as prototyping;
2. model 3D part and assemblies using solidworks programme;
3. analyze the part design using one of the computational methods (e.g. stress analysis); and
4. demonstrate understanding of the concepts of computer-aided manufacturing and a number of applied associated processes.

Course Contents

Computer aided manufacturing: operation and sequence, planning, machine definition, NC sequences and post processing. Finite element analysis: mesh types, constraints, loads, processing and interpretation of results. Data transfer. Manufacturing techniques. Maximum metal conditions, limits, and fits – MMC, BC 308 conventions, assembly drawings and parts list. Computer aided design: production drawings created from 2D and 3D CAD systems covering solid and surface modelling, mass properties, finite element analysis, rapid prototyping and computer aided manufacturing software.

AAE 405: Aircraft/Rocket Propulsion Technology (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. make design choices between jet and rocket propulsion systems based on performance issues;
2. calculate energy release such as adiabatic flame temperatures and equilibrium composition of gases at known temperature and pressure;
3. analyse the thermodynamic performance of jet engine cycles and compute relevant performance parameters;
4. perform and report preliminary design calculations to size jet engines to meet specific performance goals;
5. analyze the thermodynamic performance of simple chemical and electrical rocket cycles and compute relevant performance parameters; and
6. characterise the performance and operating/design constraints for inlets, compressors, combustors, turbines and nozzles.

Course Contents

The theories and principles of jet and rocket propulsion. Thermodynamic cycles. The mechanics and thermodynamics of combustion. Turbine engine and rocket performance characteristics. Component and cycle analysis of jet engines and turbomachinery.

AAE 407: Aerodynamics Experiment Methods, Instrumentation and Propulsion Lab (2 Units E: PH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the applications of the fundamental principles taught in aerodynamics courses;
2. exhibit basic knowledge related to experimental aerodynamics and measurements techniques;
3. become proficient in the use of basic equipment representative of aerospace engineering practice;
4. explain how to design experiments and how to conduct experiments;
5. discuss how to analyse and evaluate experimental data;
6. write good laboratory reports;
7. gain more laboratory experiences to get "hands-on" lab training; and
8. gain experiences to promote the spirit of team-work among the engineering students.

Course Contents

The laboratories introduce undergraduate students to experimental methods in aerodynamics and propulsion. Experiments include subsonic wind tunnel tests of the forces and pressures on aircraft models, wings, cylinders, spheres and spheroids. They also include design and execution of flat plate boundary layer measurement as a team effort. Gas turbine engine teaching kits are used to illustrate the principles of propulsion. Introductory topics include: wind tunnel design and layout; measurement principles for subsonic and supersonic flows. Prerequisite(s) or Concurrent(s): AAE 308, AAE 430 or consent of instructor.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/ancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

AAE 501: Aircraft/Spacecraft Design (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. provide senior engineering students a capstone experience in spacecraft design;
2. offer an opportunity for going beyond a paper product (design report) into actual manufacturing and launching of microsatellites;
3. develop creative abilities in solving open-ended, spacecraft design problems;

4. develop an appreciation of the interrelationships between aerodynamics, propulsion, structures, flight mechanics, stability & control, manufacturing, maintenance and cost in an integrated spacecraft design;
5. develop students' engineering judgment as well as their confidence in making and accepting responsibility for design decisions;
6. develop students' oral and written communication skills, necessary to describe the assumptions, methods, and results of engineering analysis, synthesis and decision-making associated with spacecraft design;
7. be aware of the importance of teamwork in the design of a spacecraft and provide them with an opportunity to develop team and leadership skills;
8. be aware of their professional and ethical responsibilities as practicing engineers; and
9. discuss the role of identity, equality, social actions and culture in aerospace
10. engineering practice (Integration of area S and engineering).

Course Contents
Introduction to the principles and techniques of the detailed design of the constituent subsystems and related support systems for an aircraft/spacecraft. Aircraft/spacecraft systems engineering: aircraft/spacecraft programme phases; system engineering techniques; design drivers; trade-offs and budgets. Reliability analysis. Case studies. Prerequisite(s) or concurrent(s): AAE 401, AAE 407 or consent of instructor.

AAE 503: Aerodynamics of V/STOL Aircraft (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the fundamentals of rotor aerodynamics;
2. explain blade element analysis;
3. discuss blade motion and rotor control;
4. describe basic helicopter performance;
5. describe the conceptual design of helicopters; and
6. explain unsteady aerodynamics, dynamic stall and rotor akes.

Course Contents
Introduction to rotary wing aircrafts: Vertical take-off and landing aircraft and short take-off and landing aircraft. The course includes elaborate discussion on helicopter aerodynamics. Rotor in vertical flight: momentum theory and wake analysis. Rotor in vertical flight: blade element theory. Rotor mechanisms for forward flight. Rotor aerodynamics in forward flight. Rotor aerodynamic design. Prerequisite(s) or concurrent(s): AAE 321, AAE 312 or consent of instructor.

AAE 504: Aircraft Maintenance Management (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. be competent in aeronautics, airframe and powerplant, aircraft instruments, communication and navigation systems, aircraft manufacturing techniques and operation, component repair and replacement, advanced maintenance and troubleshooting;
2. have knowledge of laboratory and on-the-job training and apprenticeship experiences associated with aircraft engineering technology, construction, operation, maintenance, repair and overhaul of aircraft systems and components;

3. have the basic knowledge and skills necessary to pursue technical and professional careers in aviation industry; and
4. have leadership and membership opportunities associated with appropriate professional organisations.

Course Contents

Maintenance program: requirement and purpose of maintenance. Maintenance review board and MSG-2 and logic applied to aircraft system, power plant and structures, hard-time, on-condition and condition monitored maintenance. Data collection, component history and statistical information sources. Reporting procedures, occurrence reporting and corrective action methodology. Minimum equipment list and acceptable deferred defects. Production of maintenance schedules and programmes. Aircraft maintenance and reliability: airworthiness requirements and documentation. Safety standards and safety assessment, including reliability assessment. Failure modes and failure analysis. Reliability mathematics directly associated with aircraft maintenance. Predicting system, engine and structural reliability and effect on reliability of scheduling: maintenance facilities. Provisioning and supply systems. Maintenance task, task development and analysis, downtime, repair, replacement, rectification and modification. Use of project planning methods such as CPM, PERT and computer programs to allocate timely physical and human resources. Special considerations when planning and scheduling maintenance for geriatric aircraft. Technological aids to maintenance. Future of aircraft maintenance, third party maintenance and whole life maintenance packages. Human factors in aircraft maintenance: effect on maintenance planning of human performance and limitations. Analysing human errors in aircraft management, case studies and safety considerations. Investigation of the SHEL and reason models of human interaction. Production of a management plan designed to limit human error in the execution of aircraft maintenance activities.

AAE 505: Computational Fluid Mechanics and Heat Transfer I (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. derive and demonstrate understanding of the physics of the theoretical relations in heat transfer;
2. use the simplified engineering solution methods that are used in heat transfer in order to make a quick approximation of the heat transfer for academic and industrial applications;
3. use numerical solution methods for heat transfer in order to make a detailed approximation of the heat transfer for academic and industrial applications, and to gain a physical understanding of how heat transfer occurs;
4. analyse and compare the results from different solution methods and make a quick judgment of the validity of the results;
5. explain how the theory describes the flow and temperature distributions in academic and industrial applications;
6. do project work;
7. make an oral presentation;
8. write a good report; and
9. use a mesh generation code and a CFD code.

Course Contents
Finite difference method, error and stability analysis. Applications to model equations and further developments: matrix methods, etc. Prerequisite(s) or concurrent(s): AAE 466, AAE 587 or consent of instructor.

Minimum Academic Standards

Equipment
The department must have adequate office accommodation for all the staff and laboratory/workshop for practical work. Some of the lecture spaces, auditoriums, drawing rooms, laboratories and workshop are shared with other departments.

Laboratories and Workshops
The department should meet the required minimum laboratory/workshop for the program such as:
1. Material testing laboratory
2. Thermodynamics/fluid laboratory
3. Metrology laboratory
4. General workshop
5. Solid mechanics laboratory
6. Computational fluid dynamic laboratory
7. Automobile workshop
8. Foundry workshop
9. Drawing room

Laboratory equipment required for AAE department

S/N	Description of Equipment
	Aerodynamics Laboratory
1.	Open air wind tunnel
2.	Modular airflow bench
3.	Embedded electronic development boards
	Thermo-Fluids Laboratory
4.	Free and forced vortex apparatus
5.	Loss-in-piping system apparatus
6.	Hydraulic flow bench
7.	Linear heat transfer conduction apparatus
8.	Small engine test set
9.	Refrigeration and air-conditioning training kit
10.	Flat plate solar energy collector with data acquisition accessories
11.	Focusing (curved plate) solar energy collector with data acquisition accessories
12.	Tubular heat exchanger
13.	Plate heat exchanger

14.	Flow meter calibration
15.	Modified 4-stroke diesel engine
16.	4-stroke petrol engine
17.	VDAS (Bench mounted version)
18.	Thermal expansion apparatus
19.	Thermal conductivity apparatus
20.	Francis turbine(H18)
21.	Computer-based thermal expansion
22.	Thermal radiation system
23.	Ideal gas law apparatus
24.	Venturimeter
25.	Ideal gas law stirling
26.	Adiabatic gas law apparatus
27.	Reynolds apparatus
28.	Halogen lamp
29.	Stirling engine
30.	Drop wise and film wise condensation
31.	Centrifugal pump
32	Pelton turbine
33.	Hand manual pump
34.	Orifice
35.	Compressor igniter
36.	Exhaust gas analyser
	Material Testing Laboratory
37.	Lesker Nano 36 thermal vacuum deposition system for thin film fabrication
38.	Laurell spin-coater
39.	Electro-spinner
40.	Furnace
41.	UV-Vis-NIR spectrophotometer (for solid & liquid samples)
42.	Scanning electron microscope
43.	Instron testing machine
44.	Magnetic stirrer
45.	Microscopes (fluorescence & inverted microscope)
46.	Environment chamber
47.	Fume cupboard

48.	Ultrasonicator
49.	Water bath
	General Aeronautical and Astronautical Workshop
50.	Lathe machines
51.	Drilling and milling machines
52.	Grinding machines
53.	Worktables
54.	Vice, toolboxes
55.	Rotary furnace
56.	Crusher
57.	Heat resistance electric furnace
58.	Electric tubular furnace
59.	3-in-1 planner, circular sawing and mortising machine
60.	Lift out furnace
61.	Trowel and masonry tools set, and rammer tongs
62,	Work bench
63,	Woodwork vices
64.	Woodwork planer
	Metrology Laboratory
65.	Channel temperature recorder
66.	Photo\contact tachometer
67.	Vibration meter
68.	Digital sound level meter
69.	Infrared thermal imager
70.	Hand crank generator
71.	Stroboscope
72.	Function generator/counter
73.	Manometer
74.	Pressure sensor absolute
75.	Thermistor sensor
76.	Viscometer
77.	Crank angle shaft encoder
78.	Absolute pressure/temperature sensor
79.	Motion sensor

80.	Energy transfer generator
81.	850 universal interface
82.	Potentiometer box
83.	Humidity\barometer/data recorder
84.	Multimeter
85.	Digital anemometer
86.	Thermometer
87.	Fuel flow meter
88.	Micrometre screw gauge
89.	Digital Micrometre screw gauge
90.	Venier calliper
91.	Sine wave generator
92.	Comparator
	Materials Testing laboratory
93.	Lesker Nano 36 thermal vacuum deposition system for thin film fabrication
94.	Laurel spin-coater
95.	Electro-spinner
96.	Furnace
97.	UV-Vis-NIR spectrophotometer (for solid & liquid samples)
98.	Scanning electron microscope
99.	Instron testing machine
100.	Magnetic stirrer
101.	Microscopes (fluorescence & inverted microscope)
102.	Environment chamber
103.	Fume cupboard
104.	Ultrasonicator
105.	Water bath
	Automobile Workshop
106	Automotive engine test set
107	Toyota engine anatomy teaching model
108	Toolbox
	Solid Mechanics Laboratory
109	Mass and hanger set

110	Material structure beam adapter
111	Static and dynamic balancing apparatus
112	Material photo elasticity accessory
113	Universal testing machine
114	Bridge set
	Computational Fluid Dynamics Laboratory
115	Computer workstations
116	High speed computers for CFD & CAD

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised books and journals in both physical collections and e-collections (e-resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribed repository of the following:

1. Institutions (national and international)
2. Open access sources
3. Professional bodies' e-learning platforms
4. Relevant international organisations

The library must also have adequate facilities:

1. For reading;
2. Provisions for lending; and
3. Reservation unit for specialised materials.

Classrooms, Laboratories, Workshops, Clinics and Offices

Although other laboratories and workshops not listed here will be shared with many other departments in the faculty and university in general, the laboratories and facilities listed in the table below should be provided and equipped specifically for every aerospace engineering programme.

Laboratories & Workshop Required for the Programme

S/N	Laboratory/ Workshop	Requirements	Required Size (m)
1	Aeronautical and Astronautical Laboratory	Should provide equipment and tools for practical experiments, tests (laboratory and field) and research in aerospace engineering, computer systems, relevant softwares and hardwares with supply of consumables should be provided for preparation of models and heat, and thermodynamic experiments.	18.5 x 10 x H_{RM}* (with Technologist's office and a store).
2	Aerospace Design Laboratory	Should have physical models Aero/Astro, good size wind tunnel	18.5 x 10 x H_{RM} (with Technologist's

		and other aerospace systems for research and demonstration. Computer systems and appropriate software packages for aerospace design and simulation such as Cathia, Fluent and OpenFoam. Provisions should also be made in this laboratory for other hardwares, equipment and tools for avionic design. There should also be provisions for data processing, analyses and presentation.	office and a store)
3	Drilling and Explosives Laboratory	This laboratory should have equipment and tools such as jack hammer (electric, mechanical or fluid powered) for drilling; physical models or table-top drilling rig. Tools such as hand augers. Models of explosives magazine and facilities for safe preparation of ANFO. Samples of the various initiation and detonation devices and large posters of various equipment for teaching aid.	50 x 20 x H_{RM} (With Technologist's office and a store).
4	Rocket Laboratory	At Nigeria's stage of independent existence, she should be thinking of space exploration. To this end, there must be a specialised lab for rocket and missile designs. Such lab must have provisions for polishing, mounting and finishing for teaching and research in all areas of engineering.	50 x 20 x H_{RM} (with Technologist's office and a store).

* The headroom (H_{RM}) will depend on the particular laboratory but must be sufficient to accommodate any equipment requiring high head.

The NUC recommends the following physical space requirement:

Academic	**m²**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00

Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Agricultural and Biosystems Engineering

Overview

This new agricultural and biosystems engineering curriculum contain courses that will produce Agricultural and Biosystems Engineers that will be globally competitive in a world that is now dictated by a knowledge-based economy. The desired and required competences in biological systems, process instrumentation and control, application of robots and drones to agriculture, irrigation and drainage, machine development, renewable energy and food process systems are supported by this new curriculum. The curriculum emphasises courses such as artificial intelligence, machine learning, renewable energy technologies, drone and robot technologies, project management, software engineering and design of machines and structural elements. Other courses include livestock production, aquaculture and, agroponic, instrumentation and measurement, greenhouse technology, biosystems engineering, solid modelling and environmental and social impact analysis. Agricultural and Biosystems Engineers will now have the skills to be gainfully employed as Design Engineers, Test Engineers, Product Engineers, Quality Control Engineers, Energy Engineers and Advisors, Machinery Maintenance Engineers, Waste Management Engineers, Diary Engineers, and Irrigation and Drainage Engineers. The new curriculum compares well with those of top global agricultural and biosystems engineering institutions. The synopsis of each of these courses have been made elaborate with indicated learning outcomes. In all, the new features of agricultural engineering and its transition to biosystems engineering are captured in this curriculum.

The major areas of Agricultural and Biosystems Engineering are:

1. farm power and machinery engineering;
2. soil and water resources engineering;
3. crop processing, storage and agro-industrial engineering;
4. farm structures, rural electrification and environmental control engineering;
5. forestry and wood products engineering; and
6. food process engineering.

It is pertinent to make a clarification. Global development in recent years have seen the adoption of various nomenclatures, world-wide, to define and describe the old Agricultural Engineering Programme. These include Agricultural and Biosystems, Agricultural and Environmental, Agricultural and Bioresources, Agricultural and Biological, Bioresources and Biological Engineering. The revised curriculum here applies to all these variants and is precisely adopting the name 'Agricultural and Biosystems Engineering (ABE)". This new Core Curriculum and Minimum Academic Standards (CCMAS) is a product of wide consultation with the agricultural engineering community (academic and field Agricultural Engineers) through the Nigerian Institution of Agricultural Engineers (NIAE), comparison with top universities of the world, alignment with the Council for the Regulation of Engineering (COREN) curriculum and the National Universities Commission (NUC) guidelines

Philosophy

Agricultural and Biosystems engineering encompasses the application of all engineering knowledge to solving problems encountered in agricultural production, handling and processing of biological materials for food, feed, fibre and fuel. The programme is designed to prepare students for careers in machine systems: design and provision of power for agricultural machines including renewable energies and design of machines for crop and livestock production; processing systems for food, biofuels and other by-products: crop processing and storage and post-harvest handling; natural resources system: irrigation and drainage, erosion control and water conservation; environmental system: farm structures, waste remediation and farm electrification; biological system: sensors, controls and computer models to monitor biological processes and conversion of bio-based resources to food, fuel and others. It is thus very wide and all encompassing.

Objectives

The objectives of the programme are to train engineers that are equipped with appropriate knowledge and skills to play the following roles:

1. increase and sustain agricultural (crop and livestock), aquacultural and forest production;
2. maintain a high level of agricultural production without damage or distortion to the environment;
3. minimise the drudgery associated with agricultural production by use of appropriate machinery;
4. improve rural infrastructures by providing desirable amenities for communities;
5. convert bio-based resources to food, fuel and other renewable products;
6. design new generation of devices or processes for agricultural and biological systems;
7. control agricultural and biological systems for natural resource protection, waste remediation and eco-system restoration;
8. develop sensors, control systems and computer models to monitor and control biological processes in industries or the environment; and
9. develop innovative green products and industries.

Employability Skills

This curriculum emphasises skills that can gainfully employ Agricultural and Biosystems Engineers in all agricultural, biosystems, environmental, rural and industrial environments as Design Engineers, Test Engineers, Product Engineers, Plant Engineers, Quality Control Engineers, Process Engineers, Energy Engineers and Advisers, Consulting Engineers and Environmental Engineers. They can also be employed as Irrigation and Drainage Engineers, Waste Management Engineers, Machinery Maintenance Engineers and Dairy Engineers among others.

In addition to competence and savviness in problem-solving technical, technological and modern digital skills, the programme equips the students with appropriate cognitive, critical analytical and innovative skills, emotional and behavioural skills including communication, interpersonal, continuous and life-long learning capabilities that will make them to be conscious of their importance, and the need for sustainability in relation to the consequences of their professional activities on the human environment and ecosystem.

21st Century Skills

A graduate of the Agricultural and Biosystems Engineering programme is expected to have ability to:

1. Collaboration (teamwork and ethics);
2. Citizenship (local and global);
3. Learning to learn/metacognition;
4. integrate knowledge of areas of mechanical, electrical, environmental and civil engineering, construction technology, hydraulics and soil mechanics in a variety of agricultural and biological applications;
5. problem solving/decision making/computational thinking;
6. proffer sustainable solutions for addressing society’s challenges in agriculture, food, energy, water and other natural resources by applying acquired technical, creativity and

innovative thinking and modern digital skills, which they are able to communicate lucidly; and
7. create, select and apply appropriate techniques, resources and convergent technologies, including ICT tools, artificial intelligence, machine learning, robotics, modelling, cognitive science, biotechnology, genetic engineering, nanotechnology, GIS and optimisation to agricultural, food, energy and water problems.
8. manage resources well.

Unique Features of the Programme

1. This programme compared to that of the North Dakota State University, USA, McGill University, Canada and Auburn University, Alabama, USA showed close similarity; most of the courses in the new curriculum are also offered in at least one of the world's top university, and in some cases in three of these universities.
2. This new programme has courses that support emerging engineering practices in agriculture such as the use of drones and robots, the overriding intervention of renewable energy in agriculture, the engineering of livestock and fisheries, need to deepen the design thinking and creative skills of students and the gradual shift from agricultural engineering to biosystems engineering as well as reflecting the impact of climate change on agricultural technology applications. Some of these courses are:

ABE 102: Introduction to Agricultural and Biosystems Engineering (2) units
GET 102: Engineering Graphics and Solid Modelling (2) units
GET 306: Renewable Energy Systems and Technology (3) units
GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3) units
ABE 307: Biosystems Engineering (2) units
ABE 401: Instrumentation and Measurement in Agricultural and Biosystems Engineering
ABE 501: Environmental and Social Impact Analyses (2) units
ABE 502: Aquaculture and Agroponics Engineering (2) units
ABE 503: Livestock Production Engineering (2) units
ABE 504: Greenhouse Technology (2) units
ABE 505: Drone and Robot Technology in Agriculture (2) units

3. The synopsis of most of the courses have been enriched to reflect the current practices of agricultural engineering.
4. The synopsis of the programme-based courses indicates the relevant excursion, laboratory and field practical to be undertaken by students.
5. The learning outcomes of each course is contained in this curriculum.

Admission and Graduation Requirements
Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:
1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode
For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode to 200 level, shall register for a minimum of 120 and a maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. HND holders who enter as Direct Entry candidates at 300 level shall register for a minimum of 90 units of courses and a maximum of 120 units of courses.
4. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
5. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
6. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST	ENT	Basic Sciences	Faculty (GET)	Programme (ABE)	SIWES	Total
100	4	0	16	3	2	0	25
200	2	2	0	23	0	3	30
300	2	2	0	12	20	4	24

400	-	0	0	0	0	8	8
500	-	0	0	5	14	0	18
Total	**8**	**4**	**16**	**43**	**34**	**15**	**105**

100 level

Course Code	Course title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
ABE 102	Introduction to Agricultural and Biosystem Engineering	2	C	30	-
Total		**25**			

200 Level

Course Code	Course title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	45	-
*GET 299	SIWES I	3	C	9 Weeks	
Total		**27**			

300 Level

Course Code	Course title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 304	Technical Writing and Communication	3	C	45	-

GET 305	Engineering Statistics and Data Analysis	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
ABE 301	Design of Machine and Structural Elements	2	C	15	45
ABE 302	Animal Production	2	E	30	-
ABE 303	Crop Production	2	E	30	-
ABE 304	Farm Management, Rural Sociology and Agricultural Extension	2	E	30	-
ABE 305	Soil Science	2	E	30	-
ABE 306	Land Surveying and Geographic Information System	2	E	15	45
ABE 307	Biosystems Engineering	2	C	30	-
ABE 308	Rural Infrastructural Engineering	2	E	30	-
*GET 399	SIWES II	4	C	12 weeks	
Total		**20**			

400 Level

Course Code	**Course title**	**Units**	**Status**	**LH**	**PH**
ABE 401	Instrumentation and Measurement in Agricultural and Biosystems Engineering	3	E	30	45
*GET 499	SIWES III	8	C	-	24 weeks
Total		**3**			
*Student Industrial Work Experience (SIWES**)**					
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24 weeks	
Total		**15**			

*All credited in second sesmester of 400 level

500 Level

Course Code	**Course title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
ABE 501	Environmental and Social Impact Analysis	2	C	30	-
ABE 502	Aquaculture and Agroponics Engineering	2	C	30	-
ABE 503	Livestock Production Engineering	2	C	30	-
ABE 504	Greenhouse Technology	2	C	30	-
ABE 505	Drone and Robot Technology in Agriculture	2	C	15	45
ABE 599	Final Year Project	3	C	15	90
Total		**18**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing(brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using Le Chatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;

7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;

6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II(Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

ABE 102: Introduction to Agricultural and Biosystems Engineering (2 Units C: LH 30)

Learning Outcomes

The course exposes fresh students to:

1. the contents of agricultural and biosystems engineering;
2. the diverse role and relevance of the agricultural engineering profession;
3. the career opportunities; and
4. appreciate the strategic importance of agricultural engineering in supporting and sustaining agricultural production.

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Course Contents

Philosophy and evolution of agricultural and biosystems engineering. The role of Agricultural and Biosystems Engineers in the society and human development. The relationship between agricultural and biosystems engineering and the other engineering disciplines. Significance of agricultural and biosystems engineering. Introduction to agricultural and biosystems engineering: farm power and machinery engineering; soil and water engineering; crop processing and storage engineering; farm structures and environment engineering; biosystems engineering. ABE and sustainable development. The global development goals (SDGs). Climate change impacts on agriculture, adaptation and mitigation measures; Climate smart agriculture. Career opportunities in agricultural and biosystems engineering.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Course Learning Outcomes
Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents
Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which

enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering).

Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;

11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types; 3. numerically solve differential equations using MATLAB and other emerging applications;
3. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;

4. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
5. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
6. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security

Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technologies (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;

7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers;
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

ABE 301: Design of Machine and Structural Elements (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students will be able to:
1. Explain the theories of failure of machine components;
2. Analyse the loads on machine and structural elements;
3. Apply shear force, bending moment, torsion, bending stresses in designing machine and structural elements;
4. Design machine components such as belt drives, shafts, chain drives, gears;
5. Design beams and columns;
6. Select fasteners such as nut and bolts, studs, bearings, etc. in designing machines; and
7. Use computer software and empirical methods in designing machine and structural elements.urse Content

Course Contents
Design of machine elements: Theories of failure. Design of shafts, belt and pulley drives, gears, sprockets, bolts and nuts, keys and keyways; selection of bearings. Practical session: Use of computer software in machine design.
Design of structural elements: Definitions. Hooke's law. Stress and strain due to loading. Torsion of circular members. Shear force. Bending moment and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations. Mohr cycle. Elastic buckling of columns. Design of beams using empirical methods and computer software. Design of columns using empirical methods and computer software. Group design assignment of machine or structural elements or complete system.

ABE 302: Animal Production (2 Units E: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. appreciate the basic science of animal production;
2. apply various engineering interventions in livestock housing, waste management, diary production; and
3. implement mechanization strategies in livestock production.course Content

Course Contents
Types of livestock (for eggs, milk, meat, wool, etc). distribution of livestock in Nigeria. Livestock housing. Livestock processing equipment.

ABE 303: Crop Production (2 Units E: LH 15; PH 45)

Learning Outcomes
At the end of the course, students will be able to:
1. Appreciate the various farming systems in agriculture with emphasis on Nigerian small farm holding including the impact of climate change;
2. Describe the various farm machinery used in crop production;
3. Implement mechanical operations in crop production;
4. Establish small, medium and large-scale mechanize farms;
5. Undertake the application of fertilizer types for different crops;
6. Plan and implement irrigated agriculture; and
7. Undertake some post-harvest crop processing activities.

Course Contents
Classification and ecology of crops in Nigeria. Nutrient requirements and mineral nutrition of plants. Manures and fertilizers. Plant growth and development. Growth stages. Tillage and weed control. Other cultural practices. Cropping sequences and rotation. Farming systems. Production practices for specified crops. Conservation agriculture and sustainability in tropical agriculture.

ABE 304: Farm Management, Rural Sociology and Agricultural Extension (2 Units E: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. Apply extension strategies to adopt technologies on Nigerian small rural farms from the understanding of rural sociology;
2. Apply appropriate financial system to account for farm activities with a view to practicing profitable agriculture; and
3. Take decisions appropriate to a farm establishment on staffing and machinery inputs.

Course Contents
Management decision making. Functions of management planning, organisation, staffing, directing and controlling. Financial management. Principles of extension: diffusion, adoption and rejection of innovations. Communication and leadership in agricultural extension.

ABE 305: Soil Science (2 Units E: LH 30)

Learning Outcomes
After taking this course, this course, the students should be able to:
1. apply the knowledge acquired in soil pedagogy, nutrient and nutrient exchange to managing soil fertility;
2. apply the different fertilizer types (organic and inorganic) appropriately to different soil types;
3. explain and describe the paedology, mineralogy and classification of soils;
4. undertake soil survey and mapping; and
5. manage soils for agricultural production.

Course Contents
Origin and formation of soils. Physical properties of soils. Basic concept of soil paedology. Soil colloids; soil reaction; soil mineralogy. Soil organic matter. Soil survey and mapping. Soil classification. Soil fertility and fertilizers. Particle size distribution analysis/sieve analysis. Properties and management of Nigerian soils.

ABE 306: Land Surveying and Geographical Information System (2 Units E: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. Undertake cadastral, levelling and topographic surveys essential for anti-soil erosion intervention;
2. Conduct levelling survey for road construction and farmstead planning; and
3. Use GIS to do contour mapping for contour farming and reclamation of gullies.

Course Contents
Definitions. Measurement of distances. Ise of minor instruments. Random errors. Chain surveying. Bearing of lines. Levelling. Topographic surveys. Traversing. Theodolite traversing. Plane table surveying. Triangulation. Land shaping and earthwork. Map reading. Photogrammetry. Aerial photography. Geographical Information System.

ABE 307: Biosystems Engineering (2 Units C: LH 30)

Learning Outcomes
Upon completing this course, students will be able to:
1. appreciate biological engineering processes;
2. analyse biosystems such as waste treatment systems;
3. design the various gadgets involved in unit operations in biological processes such as bio-reactors;
4. develop biosystems for energy production, municipal waste treatment; and
5. apply computer to biological systems.

Course Content

Course Contents
Definitions. Modelling and design of fermentation systems. Microbial growth kinetics. Design of bio-reactors. Heat and mass transfer. Bioremediation of wastes. design of anaerobic and aerobic systems. Energy from biological systems. Monitoring and control of biological systems. Application of computer to biological processes.

ABE 308: Rural Infrastructural Engineering (2 Units E: LH 30)

Learning Outcomes
After taking this course, students should be able to:
1. Identify the various engineering infrastructures for a rural community;
2. Plan and design rural infrastructures such as roads, earth dams, electricity projects and irrigation projects; and
3. Develop and implement a rural water scheme.

Course Contents
Concept of integrated rural development (planning and implementation). Overview of the problems of rural infrastructures. Review of agricultural construction survey. Rural road network. Rural road design, construction and maintenance; erosion of earth roads; minor road crossing. Small scale irrigation; rural electricity; rural water supplies; rural sanitation.

Practical contents: A levelling survey exercise for road construction. Excursion: Visit to an earth dam site and an irrigation project.

400 level

ABE 401: Instrumentation and Measurement in Agricultural and Biosystems Engineering (3 Units E: LH 30; PH 45)

Learning Outcomes

This course will help students to:

1. identify the appropriate instruments for measuring parametres relevant to agricultural activities;
2. manage the acquisition, transmission, recording, analysing and computing of data; and
3. apply these instruments, particularly for research in agricultural and biosystems engineering.

Course Contents

Motion, force, torque and shaft power, pressure and sound flux; humidity measurement; application of primary sensing element; data manipulation, computing and compensating devices; data transmission and recording.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

ABE 501: Environmental and Social Impact Analysis (2 Units C: LH 30)

Learning Outcomes

After taking this course, students should be able to:

1. determine the impact and consequences of agricultural projects on the environment and measure them;
2. explain the environmental policies and regulations of their locality;
3. analysis projects and take decisions as to whether it will have a positive or negative impact on the environment; and
4. design the remediation of projects with negative impact.

Course Contents

Concept of environmental and social consequences/dimensions of development projects. Methods of impact analysis. Physical, sociological, legal, economic, environmental and public health implications of human activities. Effects of changed environments on man. Examples of impact assessment with particular reference to developing countries. Role of environmental engineering in preventing or reducing environmental stress. Environmental and social management plans (ESMP); Planning and policy, administration and organisation of natural resources development and public health. Land use planning and landscape design. Monitoring and evaluation of projects for ESIA compliance. Practical content: Students are expected to undertake an environmental and social impact analysis of an on-going project on campus.

ABE 502: Aquaculture and Agroponic Engineering (2 Units C: LH 30)

Learning Outcomes

Students will after taking this course have the capacity to:

1. appreciate fish farming, the machinery involved and integration of fish farming aspect to the other crop and livestock enterprises on a farm;
2. design mechanized fish ponds, conserve water, manage the wastes from the ponds;
3. design and construct efficient fish drying kilns; and
4. explain the benefits, practice and management of agroponic agriculture.

Course Contents

Aquaculture: Types of fish ponds. Design and construction of fish ponds. Integrated fish farming. Water quality for fish farming. Water conservation. Machinery for fish farms. Pollution control. Ecological re-use and disposal of water. Product harvesting, sorting and processing. Design of fish kilns. Agroponics: Agroponic farming systems. Prospects of agroponic agriculture in Nigeria. Soil and water management in agroponic systems. Economics of agroponic systems. Modern aquaponics and hydroponics systems design and use. Practical content: Each student is expected to plant a yam seedling in a bag of sand and monitor its growth until harvest during the semester. Excursion: Visit to a commercial fish farm site or the university fish farm.

ABE 503: Livestock Production Engineering (2 Units C: LH 30)

Learning Outcomes

After taking this course, the students will be able to:

1. Explain the various rearing systems including the transhumance system of rearing;
2. Describe the production systems in the livestock enterprise;
3. Design livestock housing types;
4. Identify the various engineering interventions in the livestock enterprise, which include the machinery for feeding, sanitation of the livestock housing, milking, irrigation of the pastures in a ranch;
5. Plan, design and implement a ranch;
6. Select appropriate machinery for various operations; and
7. Manage livestock wastes for energy production.

Course Contents

Production systems: rearing, fattening and milk production systems. Rearing systems: objectives; nomadic, transhumant, sedentary, scavenging and industrial (ranching) – organisation, personnel and infrastructures. Design, construction and equipment for housing for pigs, sheep, goats, domestic fowls, cattle and dairy cattle. Fattening production systems: Grass and intensive fattening. Milk production systems: factors limiting tropical milk production; milking bail; milking parlour: selection, design and types.
Environmental requirements for animals. Environmental impact on animal growth and reproduction on their general physiology. Assessment of thermal comfort. Parametres affecting thermal comfort of animals. ASHRAE comfort charts. Ventilation systems: natural and automated. Aerodynamics of animal buildings. Building design methodology. Integrating animals with their environment through building designs.
Disease control: Causes, factors favouring transmission. Design of buildings to control diseases. Animal waste management: Characteristics of animal wastes. Objectives of waste treatment; aerobic and anaerobic treatment of waste; manure disposal equipment.
Excursion: Visit to a functional biogas plant.

ABE 504: Greenhouse Technology (2 Units C: LH 30)

Learning Outcomes

Students are expected to be able to:

1. Define greenhouse and associated technologies;
2. Describe the types of greenhouses;
3. Analyse the thermal profile of greenhouses;
4. Determine the influence of the climate on the control and implementation of the environment in greenhouses;
5. Undertake climate control and cultivate plants in greenhouses; and
6. Design and construct low cost and effective greenhouses for crop cultivation.

Course Contents

Definition of greenhouse. Meaning of greenhouse technology and controlled environment agriculture (CEA). History and present scenario of greenhouse cultivation. Importance of greenhouse crop cultivation. Types of greenhouses. Types of covering materials and thermal screens for greenhouses. Planning of greenhouses. Importance of different

climatic and non-climatic factors in selecting proper greenhouse technology. Measuring systems required for greenhouse. Design, construction and cost estimate of a greenhouse. The bamboo greenhouse technology. Control mechanisms for different climatic conditions: light, temperature, humidity, precipitation and carbon dioxide. Special methods of crop husbandry in greenhouse cultivation.
Excursion: Visit to a commercial farm with greenhouse facility.

ABE 505: Drone and Robot Technology in Agriculture (2 Units C: LH 30)

Learning Outcomes
This course will enable students know control, tools, programming languages, sensors and actuators involved in automation; design and use of robots and drones in agriculture.
Students are expected to be able to:

1. Identify and explain the forms of automation and its control systems, automation tools and various computer programming languages;
2. Explain the types and application of sensors;
3. Design and select sensors and actuators;
4. Describe and explain the types, classification and architecture of drones;
5. Explain the types, characteristics and advantages of agricultural robots;
6. Apply drones and robots in agriculture; and
7. Evaluate the performance, accuracy and repeatability of robots.

Course Contents
Automation: Introduction to automation. Control systems: open-loop and closed-loop, feedback control, logic control, on-off control and linear control systems. Control actions: discrete control (on/off); PID controller; sequential control and logical sequence or system state control; computer control. Automation tools: artificial neural network (ANN); distributed control system (DCS); human machine interface (HMI); robotic process automation (RPA); supervisory control and data acquisition (SCADA); programmable logic controller (PLC); instrumentation; motion control; robotics. Programming languages: introduction to programming language; Matlab programming, R programming, C, C# and C++ programming, Java and Java Script programming and Python programming. Sensors and actuators: introduction to sensors, types and applications. Design and selection of sensors. Introduction to actuators, types and applications. Design and selection of actuators.
Drones or Unmanned Aerial Vehicles (UAVs): Introduction, types and classification of drones. Architecture (components) of a drone: flight controller; electronic speed controller (ESC); battery; radio transmitter/receiver; antenna; propellers; electric motor; camera and its accessories.; ground station; intelligent sensors; intelligent battery; GNSS and RTK module. Advantages and disadvantages of drones. Design and selection of drones. Working principles of a drone. Performance considerations criteria of a drone. Application of drones in agriculture.
Robots: Introduction, types and characteristics of agricultural robots (Agribot). Primary areas of robotics: operator interface; mobility or locomotion; manipulators and effectors; programming; sensing and perception. Advantages and disadvantages of robots. Robot design process. Design of components of agricultural robots: end effectors; grippers; manipulators. Operating principles of an agricultural robot. Performance evaluation of robots: productive time, overhead time and working efficiency index. Accuracy and repeatability of a robot. Application of robot to agriculture.

ABE 599: Final Year Project (3 Units C: 15 LH; PH 90)

Learning Outcomes

The project will enable students to:

1. Synthesis all that was learnt in the programme to develop a technology or obtain data that can be deployed to solving a major agricultural and biosystems engineering problem.

Course Contents

Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

Minimum Academic Standards

Equipment

Minimum Laboratories, Workshops and Studios

Category	**Minimum Requirement**
Laboratories	Farm Power and Machinery Engineering
	Soil and Water Engineering
	Agricultural Processing and Storage Engineering
	Farm Structures and Environmental Control Engineering
Workshops	Farm Mechanics
	Machinery Maintenance
Studio	Engineering Graphics and Drawing

List of Laboratories/Workshops/Equipment/Instruments/Tools

Farm Power and Machinery Laboratory

S/No.	**Equipment**
1	Tractors for field operation
2	Disc and moldboard ploughs
3	Disc ridger
4	Disc harrow-offset and tandem
5	Planter with fertilizer unit
6	Seed drill
7	Hydraulic boom and hand sprayers
8	Grain combine harvester
9	Agricultural trailer
10	Conveyor test belt
11	Knapsack sprayer test rig
12	Tillage and traction model study unit
13	Single cylinder engine test bed
14	Variable compression ration petrol engine test bed
15	Tractor power take-off dynamometre
16	Exhaust calorimetre heat exchanger
17	Fuel consumption measurement system for engine testing
18	Lubricating oil rig
19	Hydraulic power pack
20	Tractor model showing working parts
21	Six speed gear box
22	Tractor real axle section

23	Tractor electrical system
24	Basic transducers for measuring torque, pressure, temperature, etc.
25	Tachometre
26	Single Axle Tractor
27	Blacksmith Furnace
28	Soil Bin for traction Studies
29	PTO 3-pt linkage Dynamometre
30	Drawbar Dynamometre
31	Ergometre (Hand, Bicycle)
32	Stethoscope
33	Oxygen metre
34	Four-cylinder engine test bed
35	Soil cone penetrometer
36	Solar PV modules
37	Inverters
38	Charge controllers
39	Deep cycle batteries
40	Solar PV training kits
41	Gas chromatograph analyseanalyser for biogas
42	Laboratory anaerobic digester systems
43	Laboratory wind turbine
44	Laboratory wind energy conversion kit
45	Laboratory hydro-power kit
46	Mechanical tool box
47	Electrical tool box
48	Solarimetres
49	Sun metres

Soil and Water Laboratory

S/No.	**Equipment**
1	General Purpose Theodolite
2	Liquid prismatic compass
3	Surveyor's umbrella
4	Stereoscope
5	Nylon-coated steel tapes-50m
6	Leveling staff
7	Abney level
8	Planimetres
9	Physical Survey Basic Set (Pocket Altimetre, range finder, automatic level set, double prismatic square, ranging rods, land chains-30m, chain, arrows, clinometres)
10	Soil Sampling Augers
11	Soil Texture set
12	Sieve sets with shaking machine
13	Centrifuge
14	Weighing balance
15	Tension metres
16	Double ring Infiltrometre
17	Various types of flumes

18	Current Metres
19	Pump test set
20	Pump impeller display panel
21	Laboratory infiltration apparatus
22	Sprinkler irrigation set
23	Drip irrigation set
24	Rainfall simulator
25	Rain gauges
26	Hydrological cycle apparatus
27	Constant head permeametres
28	Falling head permeametres
29	Oven
30	Irrigation pipes
31	Beakers
32	Funnels
33	Measuring cylinders-10ms
34	Plain roller
35	Thermometres
36	Hydrometres
37	Rammers
38	Compaction mould
39	Spatula
40	Soil scoops
41	Tensiometre
42	Permeametre
43	Penetrometre/Penetro-logger
44	Soil auger
45	Soil extruder
46	Portable soil metre
47	Analytical balance
48	Electrical balance (3kg)
49	Timer (electric)
50	Stopwatch
51	Liquid limit device machine
52	Glass plate for plastic limit
53	Proctor mould
54	Density bottle
55	High speed stirrer
56	Automatic soil compactor
57	Shrinkage limit apparatus
58	Neutron probe
59	Lysimetres

Agricultural Processing and Storage Laboratory

S/No.	**Equipment**
1	Standard Rheometres (Digital)
2	Standard Rheometres (Analogue)
3	Muffler furnace
4	Refrigeration and air conditioning cycles kits impact test apparatus (ACV)
5	Elastic behaviours test kits standing hydraulic press

6	Portable crane hoist
7	Vernier calipers
8	Micrometre screw gauges
9	Extrusion press
10	Strain gauges
11	Steam boilers
12	Assorted measuring tools
13	Assorted woodwork tools
14	Assorted carpentry tools
15	Various hand tools
16	Assorted instruments
17	Assorted tools for maintenance, repairs
18	Gas calorimetres
19	Bomb calorimetres
20	Power jack
21	Stroboscope
22	Grading machine
23	Laboratory gravity separator
24	Hammer mills with kit
25	Burr mill with kit
26	Sets of Tyler sieves
27	Métier Electronic (digital readout) balance Universal testing machine)
28	CBR machine (digital)
29	Wind Tunnel (terminal velocity equipment)
30	Drum-type mixers
31	Vibrators
32	Thermocouple print thermometres
33	Crack detection microscopes
34	Ordinary microscopes
35	Modulus of elasticity kit
36	Electronic extensometer
37	Pendulum impact tester
38	Dry-ice maker
39	Hydraulic extruder
40	Dry shrinkage test machine
41	Colour standard test
42	Laboratory air compressors
43	Moisture determination balance
44	Stop watches, omega
45	Conductivity metre (Wind tunnel for TV)
46	Magnetic stirrers
47	pH-metre (Digital)
48	Laboratory trolley wheel barrows portable digital press
49	Dry mixers
50	Muffle oven
51	Infra-red moisture metre
52	Dryers
53	Drying test apparatus
54	Centrifugal fans
55	Axial fans

56	Cold storage cabins
57	Cabinet refrigerators
58	Deep freezers
59	Humidity measuring equipment
60	Incubations
61	Microwave ovens
62	Air conditioning units
63	Tachometre
64	Robin mixers
65	Tensiometre
66	Silos
67	Shelling machine
68	Centrifuge, standing type
69	Planimetres
70	Stabilizers
71	Laboratory air cleaning machine
72	Laboratory sorting machines
73	Laboratory grading machines
74	Laboratory gravity separators
75	Grain storage bins
76	Centrifugal fans
77	Axial flow fans
78	Grain moisture metres
79	Compression testing machine
80	Tension test machine
81	C.B.R Marshall Tester
82	C.B.R Mould and accessories
83	Feed mill (complete)
84	Apparatus for tensile tests
85	Apparatus for compression tests
86	Bulk density measuring machine
87	Portable water pumps
88	Grain storage bins
89	Thermometres
90	Sieve shakers
91	Digital weighing balances
92	Standard floor weighing machine, 1000kg
93	Top loading electronic balance
94	Sunshine recorders
95	Standard drawing boards sets
96	Coefficient of friction test apparatus
97	Table top inclination plane (Adjustable)
98	Standard inclination plane (Adjustable)
99	Electrical motor- 10hp
100	Thermographs
101	Pre-cleaners
102	Oil expellers
103	Juice extractor
104	Desiccators
105	Stop watches/clocks

106	Rotary evaporators
107	Gas chromatograph
108	pH-metres
109	Egg incubator
110	Glassware (Assorted)
111	Standard generator
112	Individual computer set
113	Laptops
114	Printers
115	Special computer tables
116	Complete public address sets, high voltage, high frequency
117	Projectors
118	Field vehicles
119	Photocopiers
120	Laboratory chairs, tables, and complete formwork

Farm Structure and Environmental Control Laboratory

S/No.	Equipment
Load Measurement Equipment	
1	Compression testing machine
2	Integral boss load measuring rings on compression and tension application
3	100-kN compression/500-kN tension machine
4	33-kN flexural and transverse machine
5	100kN heavy beam flexural and transverse machine
6	Drying and weighing:
7	General purpose electric laboratory oven
8	Incubators
9	Electronic weighing machine
10	Semi-automatic balance
11	Counter flat form scale
12	Mettle weighing machine
13	Spring balance
Soil Equipment	
1	Melting pot
2	Extruder (big and small)
3	Sample mixer
4	Liquid limit device machine
5	Grooving tools
6	Spatulas (big and small)
7	Measuring cans
8	Glass plate for plastic limit
9	Shrinkage limit apparatus
10	Density bottle
11	High speed stirrer
12	Hydrometre (big and small)
13	Standard compaction rammer
14	Automatic soil compactor
15	Procter mould
16	Compaction mould
17	C.B.R -Marshall Tester

18	C.B.R -Mould and accessories
19	Sand cone
20	Trays (big and small)
21	Scoops
22	Desiccators
23	Field density tools
24	Field density spoons
25	Field rubber headed mailer
26	Field club hammers
27	Field density chisel
28	Field metal dibber tool
29	Field scrappers
30	Field density hand pick
31	Field steel pointed rod
32	Glass jar
33	Mortar
34	Rubber headed pestle
35	Glass evaporating dish
36	Filter paper
37	Conical beaker
Concrete Equipment	
1	Slip test apparatus
2	Compacting factor apparatus
3	Penetrometre
4	100mm cube mould
5	150mm cube mould
6	Bean mould
7	Cylinder mould
8	Standard curing tank
9	Three-gang mould for 50mm mortal cube
10	Hand steel float
11	Head pans
12	Wheel barrows
13	Diggers
14	Band trowel
Sand Aggregates and Fillers Equipment	
1	Aggregate impact value apparatus abrasion machine
2	Metal measurement (115mm x 180mm deep)
3	Asphalt Equipment
4	Thermometre
5	Laboratory thermometer
6	Surface thermometer
7	Muffler furnace
8	General Equipment
9	Distiller
10	Measuring tapes
11	Refrigerator
12	Stain gauge indicators
13	Sieve shakers
14	Sets of sieves

15	Set of 200mm diametre (various sizes)
16	Set of 300mm diametre (various sizes)
17	Set of 450mm diametre (various sizes)
18	Vanier caliper
19	Shear box
20	Oedometre (Consolidometre)
21	AAS
22	Automatic weather station
23	Current metre
24	Geometre
25	High performance liquid chromatography (HPLC)

Agricultural Engineering Workshops
Farm Mechanics Workshop

S/No.	Equipment
Measuring Tools and Instruments	
1	Pocket rule with belt clip (235m)
2	Steel measuring tape caliper rule
3	Procession external micrometre
4	Universal measuring instrument for depth measurement
5	Procession inside micrometre
6	Dial indicator
7	Outside spring caliper
8	Inside spring caliper
9	Metal bar divider
10	Precision tri square
11	Metric threading gauge
12	Wielding and soldering accessories
13	Wielding shield
14	Wielding helmet
15	Goggle clear
16	Wielding goggle
17	Electrode holder
18	Earth clamp
19	Wielding hammer
20	Wire brush
21	Wielding and cutting touches set oxygen acetylene hoses
22	Safety helmet
23	Working and wielding gloves
24	Blowlamp with butane
25	Electrode-All sizes
26	Soldering iron (all sizes light-heavy duty)
27	Soldering lead wire (2mm)
28	Soldering lead in rod
Workshop Hand Tools (Technicians)	
1	Hacksaw frame
2	Hacksaw blades high speed steel Tube cutter 3 – 32mm; 3 – 16mm
3	Steel wire brush
4	Clip plier for external clip
5	Clip plier for internal clip

6	Combination of plier (160, 180mm)
7	Heavy duty diagonal cutter constructed steel cutter (800mm)
8	Universal grip plier (250mm)
9	Welding grip plier (280mm)
10	Riveting tool set
11	Engineering hammer (200g – 250g)
12	Sledge hammer
13	Rubber hammer
14	Clipping chisel (150 – 250mm)
15	Welding hammer
16	Standard ring spanners
17	Combination spanner set
18	Scrapper
19	Hand gloves
20	Centre punch set (120x12) mm
21	Chisel set
22	Flat file (150-300) mm
23	Square file (150-300) mm
24	Half round file (150-300) mm
25	Round file (150-300) mm
26	Blacksmith tong (150-300) mm
27	All steel vices (100-175) mm
28	Pipe cutter (10-60) mm; (42-10) mm
29	Anvil with two horns (100 kos)
30	Technician tool box (empty)
Woodwork Equipment	
1	Band saw-table size-700 x 980mm - 3hp
2	Radial arm saw 3hp (with extra blade)
3	Circular saw-blade dia-400mm with external blades
4	Universal woodworker combined-4hp seven works model
5	Single cylinder planner-4hp (surface planner with extra blades)
6	Vertical Motorize-chain motorise-3hp with extra bits
7	Router drilling machine-3hp
8	Combined tennoning and scribing machine
9	Belt sanding machine-2hp (with extra sanding paper reels)
Hand Tools (Carpentry)	
1	Marking gauge
2	Mortise gauge
3	B. spirit level universal
4	Motorize chisel-(6.4, 9.6, 12.7, 16) mm
5	Flat chisel-(6.4, 9.6, 12.7, 16) mm
6	Bevel edge chisel – (6.4, 9.6, 12.7, 16) mm
7	Round chisel (6.4, 9.6, 12.7, 16) mm
8	Smooth plane-jack plane, plough plane
9	Wood rasp
10	Hand saw or panel saw
11	Ripsaw, crosscut
12	C- Clamp
13	F- Clamp
14	Wood bench vice

15	Jack plane
16	Hand drilling machine/rachet brazed bits
17	Sanding machine-heavy duty
18	Surface and thickness (100-150) mm blade
19	Extra knives carpentry machine planner and thicknesser
20	Air compressor-tank capacity 500 litres complete with accessories-type spray gun and air blow-gun
21	Hydraulic garage jack (1, 2, 6 ton)
22	Hydraulic workshop crane (2.5 tones)
23	Battery tester, cell tester, acid tester
24	Battery fast and slow charger (6-24V,20Λ)
25	Battery service equipment
26	Spark plug tester and cleaner
27	Hydraulic mobile crane (1.5 – 5tons)
28	Wire rope winch- (1500 – 3000kg)
29	Chain host
30	Pedal operated grease gun
31	Hand lever grease gun
32	Exhaust gas tester
33	Standard tool box mechanics
34	Standard tool box for electricians
35	Electric hand drill 100mm
36	Electric two speed drill 23mm
37	Electric hand drill 13mm
38	Straight electric hand grinder 125mm
39	Angle electric hand grinder 230mm

Machinery Maintenance Base

S/No.	Equipment
1	Hydraulic trolley
2	Wheel alignment gauge
3	Electrical/Electronic kit
4	Clutch alignment gauge
5	Vacuum tester
6	Battery charging equipment
7	Injector repair machine
8	Carburetor service kit
9	Hydraulic press
10	Vulcanizing set
11	Oxyacetylene equipment
12	Nozzle testing outfit
13	Tool boxes
14	Complete set of various maintenance kits

Engineering Graphics and Design Studio

S/No.	Equipment
1	50 Computer work stations with design and graphic software from the AutoCad suite (FUSION 360, etc.), 3-D printers and accessories.
2	50 drawing boards and T-squares
3	Large screen and projector

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 18 credits per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical and supervision of projects. Each workshop or laboratory should have adequate number of staff with the right mix, so that each unit or section in that workshop or laboratory can run efficiently.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staffs that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m²**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Automotive Engineering

Overview

The Automotive Engineering curriculum contains courses that will produce automotive engineers that are competent in the mechanics of auto-engines, its design, fabrication and maintenance. This will help in providing solutions to vehicular problems where existing artisans are not capable of diagnosing or solving the problem. The world is moving away from the combustion of conventional fossil fuel to power vehicular engines into a new era of the application of various renewable energy sources. This generation of automotive engineers will be the ones to bring this about. The new curriculum, therefore, contains courses such as: Automotive Internal Combustion Engines; Fuels and Fuel Sources – fossil and renewable; Renewable Energy Systems and Technology; Artificial Intelligence Machine Learning; Theory of Machines; Dynamics and Control; Automobile System Design; Applied Thermodynamics, Applied Aerodynamics; Automotive Vehicle Dynamics and Safety; CFD for Engineering; Advanced Computer Aided engineering; Mechatronics.

Philosophy

The programme's philosophy is to produce graduates who are capable of handling any brand of vehicle manufactured anywhere in the world; andto produce graduates who are able to design, fabricate and assemble vehicles using locally available materials, and switch to new waves of existing and emerging renewable energies in propelling vehicular motion. It is aimed that the graduates of this new curriculum should be able to combine sound theoretical background with practical skills to enable them to take up challenging positions in the automotive and manufacturing industries; and stand on their own in the auto-industry, employing their skills in Entrepreneurship, Engineering Management and Engineering Law to create auto-companies that create jobs and become employers of labour.

Objectives

In consonance with the philosophy, the Automotive Engineering Programme is designed to produce graduates who can;

1. employ fundamental concepts of science, engineering mathematics and entrepreneurship in automotive engineering.
2. plan, design and fabricate modern internal combustion engines which are capable of being used for short and long distance transportation;
3. plan, design and fabricate durable engines for long and heavy-duty transportation;
4. have capacity to come up with good chassis vehicles that will be able to withstand the harsh nature of the roads in Nigeria and other similar terrains elsewhere in the world;
5. plan, design, fabricate and assemble vehicles with good aerodynamic stability on any terrain in the world;
6. design, fabricate and assemble auto-vehicles which are capable of employing different sources of renewable energy as a power source;
7. employ computer software to develop vehicles and other auto-engines that will be capable of being used on land and water;
8. employ knowledge of mechatronics dynamics control, advance aerodynamics to develop potable vehicles that have the capacity to be used on land and air;
9. have the capability to maintain various brands of vehicles employing diagnostic tools and the computer to detect and provide solutions to engine faults; and
10. be sufficiently practically oriented to be self-employed.

Employability Skills

Graduates of this Automotive Engineering curriculum will have strong career prospects in both public and private sectors. In the public sector, they will be readily employed in all parastatals of government as vehicle pools engineers or as auto-mobile maintenance engineers. They will equally be employed in almost all fields of engineering that require mechanical engineers. In the public sector, they can be employed in virtually all engineering environments where there is need for transportation, aerospace maintenance, marine propulsion, petroleum, chemical application and, most especially, automotive skills . In the private sector they will also be engaged as design engineers, Internal combustion engineers, chassis engineers, auto-production engineers, simulation maintenance engineers, vehicle sales or purchasing engineers, auto-materials parts specialists, auto-diagnostic engineers, internal combustion engine development engineers, auto-business managers, power generating plant professionals, and railway and metro-line service providers.

21st Century Skills

The graduates of Automotive Engineering Programme are able to have the capacity to:

1. critical thinking/problem solving/decision making;
2. creativity and innovation;
3. learning to learn/metacognition;
4. communication;
5. collaboration (teamwork and ethics);
6. computational thinking;
7. information literacy; and
8. citizenship (local and global.
9. design modern auto-engines, employing various software and CAD/CAM System to

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Year	GST/ENT	Basic Sciences	GET Courses	Programme Courses	SIWES Courses	Total
1	4	18	3	1	-	26
2	4		26	0	3	33
3	4		18	0	4	26
4	-			0	8	8
5	-		5	7	-	12
Total	**12**	**18**	**52**	**23**	**15**	**105**

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45

CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY107	General Practical Physics I	1	C	-	45
PHY108	General Practical Physics II	1	C	-	45
GET 101	Engineering in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling	2	C	15	45
TAE 102	Introduction to Automotive Engineering	1	C	15	-
	Total	**26**			

200 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: SWEP	3	C	9 Weeks	
	Total	**30**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
TAE 302	Automotive Internal Combustion Engines	3	E	30	45
*GET 399	SIWES I: Students Work Experience Scheme	4	C	12 Weeks	

	Total	**22**			

400 Level

Course code	Course Title	Units	Status	LH	PH
TAE 403	Automobile System Design	3	E	30	45
TAE 405	Finite Element Analysis of Structures	2	E	30	-
TAE 407	Applied Aerodynamics	3	E	45	-
TAE 409	Dynamics and Control	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

SIWES Courses*

GET 299	SIWES I: SIWEP	3	C	9 weeks
GET 399	SIWES II: Student Industrial Work Experience Scheme	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

* All to be credited in the 2nd Semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TAE 502	Automotive Materials and Structures	2	C	30	-
TAE 505	Automobile Vehicle Dynamics and Safety	2	E	45	-
TAE 555	Project	5	C	-	270
	Total	**12**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing[brainstorming and outlining], writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication.The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;

2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;

5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;

4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

TAE 102 : Introduction to Automotive Engineering (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. activate students' interest in automotive engineering;
2. make them understand their significance to the national economy; and
3. enable them to appreciate the use of automotive engineering in public and private sectors.

Course Contents

Definition of automotive engineering. History of automotive engineering. The automotive engineer; automotive engines and its growth; the role of automotive engine and engineer in transportation. Automotive engine and parts maintenance. Areas of automotive engineer's employment. General automotive business.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;

4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Course Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and

6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;

5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and

5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and

modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;

3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technologies (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,

4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. Design of machine compone;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

TAE 302: Automotive Internal Combustion Engines (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify internal combustion engines;
2. describe all types of fuels available for combustion in the internal combustion engines, efficiency of the combustion and the relation this has with pressure ratio;
3. state the environmental impact of the combustion of the fuels due to exhaust emission; and

4. state the implications of design on the combustion efficiency of internal combustion engines.

Course Contents
This course introduces students to internal combustion engines, their efficiency and pollutants emission. It looks at the various emerging power technologies in the automotive industry and the current and alternative fuels and combustion processes. Choice of fuel and the design of efficient engine operating parameters and their by-products will also be discussed.

400 Level

TAE 403: Automobile System Design (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. carry out the design of engine block;
2. identify the chassis;
3. develop steering system; and
4. explain mechanical transmission system.

Course Contents
Auto engine design; design of steering systems; design of transmission systems.

TAE 405: Finite Element Analysis of Structures (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. use finite element;
2. explain solid works soft-ware and other soft-wares in the design and
3. identify simulation of engineering problems in automotive engineering.

Course Contents
Finite element analysis to solve problems related to solid mechanics, dynamics and heat-transfer. In particular, students will have hands-on experience in using finite element analysis software ANSYS and MSC Nastran to solve realistic engineering problems.

TAE 407: Applied Aerodynamics (3 Units E: LH 45)

Learning Outcomes
This course will introduce students to;
1. the fundamentals and practical aspects of incompressible and compressible flows;
2. the design and operation of flow systems; and
3. including pipe networks, automobiles and flight vehicles.

Course Contents
Flow of inviscid and viscous fluids. Laminar and turbulent flow in pipes and boundary layers. Losses in pipe systems. Lift and drag forces on moving bodies and aerofoil theory. Incompressible-flow machines. Fundamentals of compressible flow. 1-D pipe flow. Compressible flow nozzles. Rayleigh flow. Fanno flow. external compressible flow around bodies including transonic and supersonic vehicles. Design considerations. Experimental techniques.

TAE 409: Dynamics and Control **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the implication of vibration in automotive engineering; and
2. and the significance of its control.

Course Contents

Dynamic systems are found everywhere, from musical instruments to transportation vehicles such as automobiles and aircraft. Even static civil structures such as bridges and buildings exhibit a dynamic response, which must be considered during design and construction of such systems. This course introduces the fundamental concepts of vibrating dynamical systems, from single degree of freedom systems through to continuous and multi-degree of freedom systems. Design of vibration control devices, such as vibration isolators and vibration absorbers, is also considered. Concurrently with the introduction to vibratory systems described above, this course also addresses how to control such dynamic systems using modern state-space control. This involves time domain descriptions of dynamic systems using state-space system models. The characteristics responsible for the dynamic response (poles, zeros, eigenvalues) are presented. Control laws using state-space are introduced, including specification of controller characteristics, controller design using pole placement and optimal (LQR) control (introduction). State observers are presented, including observer design using both pole placement and optimal (Kalman) observers (introduction). Finally, a computer aided control system design methodology is applied to a real MIMO aerospace platform and several other unstable MIMO systems.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and

4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

TAE 502: Automotive Materials and Structures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify practically materials available for automotive parts; and
2. to enable them decide to accurately make the right selection in material.

Course Contents

Examination of different materials used in the automotive industry, including metals, ceramics and composites. Discussion of selection of the appropriate material for a variety of applications in terms of the materials' properties, ease of manufacture and performance in the anticipated service environment. Case studies of selected materials in the design application of each of these materials for automotive parts. The course develops an understanding of the mechanics of complex practical situations through the establishment and solution of an appropriate boundary value problem.

TAE 505: Automotive Vehicle Dynamics & Safety (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. appreciate the aerodynamic stability of vehicle during use; and
2. help students in ergonomics and vehicle stability design.

Course Contents

Automotive vehicle dynamics and safety; dynamics of vehicles on the road during normal operation as well as during impact and other crash scenarios; and discuss specific topics including vehicle handling, stability and control, tyre dynamics, suspension design, braking performance, automotive safety, impact dynamics, road safety engineering and safety regulations.

TAE 506: Automobile Maintenance and Testing (2 Units: C,: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
Show enhanced capability of students in handling day-to-day maintenance of vehicles.

Course Contents

Check spark plugs, injectors, air filters, water level, engine oil level, engine oil viscosity, air filter, transmission fluid level, coolant water level, tire gauge and wear, wheel balancing, exhaust catalytic system, pipe and holes damage.

Minimum Academic Standards

Equipment

Laboratories

Properties of air-fuel mixtures;
Effect of mixture strength on ignition and flame;
Formation, flame velocity, combustion rate, peak pressure and temperature; and
Engine emission and omission control.

Automobile systems and vehicle dynamics laboratory

Performance and reliability of brake systems
Carburetors and injection nozzles
Performance characteristics of components of ignition system
Performance of batteries, alternators, voltage regulators, etc
Performance characteristic of power transmission system
Vehicle body shape and air resistance
Factors affecting tyre wear rate
Effect of tyre pressure on road traction (fuel consumption) and maneuverability
Maneuverability of vehicles

Automobile systems design maintenance and testing laboratory

Design of system components for production
Testing of models and prototypes
Testing of vehicles for off-design performance
Schedules for preventive maintenance for various automobile components, taking local conditions into consideration.
Calibration and operation of test equipment
Crank shaft grinder
Cam shaft grinder
Valve grinder
Pedestal grinder
Cylinder boring machine
Hydraulic ramp
Portable crane
Compressor
Mechanical press
Plug re-conditioning machine
Battery charger
Beam setter
Centre lathe 349
Chain block
Torque wrench (various)
Tool kit, stock and dies
Dynamic performance testing unit

Automobile workshop

Auto pit
Auto engine rigs
Auto transmission systems
Wheel balancing and alignment equipment
Panel beating apparatus

Welding equipment
Production facilities for simple automobile parts
Apparatus set-up for fault tracing and repair of automobile systems including engine overhaul
Lubricating oil tester
Laboratory Equipment
Petrol engine with dynamometer
Diesel engine with dynamometer
3000^{o}C electric furnace
Computer controlled super service wind tunnel (3 blades)
Computer controlled aerodynamic tunnel 50x250mm
Aerodynamic tunnel 50x250mm
Flow visualization aerodynamic tunnel
Wind tunnel flight unit
Aerodynamic testing demonstration bench
Two-shaft gas turbine/jet engine
Computer controlled steam motor & engine conversion unit
Computer controlled steam power plant adjustable up to 20kw
Computer controlled jet propulsion study unit
Computer controlled test bench for single cylinder engine (7.5 kw)
Computer controlled exhaust gas calorimeter
Exhaust gas Analyser
Computer controlled test bench for hybrid engine
Unit to study sample drive assembly
Acceleration of gear system unit
Unit to study combined drive assembly
Unit to study gear train assembly
Braking & accelerating force unit
Plate clutch
Single hydraulic unit
Geared study unit
Gear box
Epicyclic gear unit (1 Element)
Epicyclic gear unit (2 Element)
Epicyclic gear unit (3 Element)
Borg-warner automatic transmission
Differential crown-wheel & pinion
Overdrive unit
Static & dynamic balancing unit
Computer controlled test bench for 4-cylinder engine (75 kw)
Drum brake unit
Disk brake unit
Digital engine diagnostic equipment
Crank shaft grinder
Cam shaft grinder
Valve grinder
Pedestal grinder
Cylinder boring machine
Hydraulic ramp

Portable crane
Workshop service compressor
Mechanical (Manual table) press
Plug re-conditioning machine
Plug re-conditioning machine
Battery charger
Beam setter
Centre lathe 349
Chain block
Torque wrench (various)
Tool kit, stock and dies
Dynamic performance testing unit
Standard auto-service pit
Auto engine rigs
Auto transmission systems
Wheel balancing (dynamic type) and alignment equipment (digital type)
Panel beating apparatus
Welding equipment
Production facilities for simple automobile parts
Apparatus set-up for fault tracing and repair of automobile systems including engine overhaul
Lubricating oil tester
Hydraulic press (100 tonne)
Hydraulic jack
Brake testing equipment with control panel
Electric vulcanizer
Work benches
Bench vices
Pneumatic tyre removal equipment
Injector pump test bench
Master cylinder test equipment
Universal battery charger
Engine mounting stand
Hydro-meters
Trolley jacks
Foot operated grease dispenser
Electric hand drill
Airline pressure gauge
Portable tyre inflator (manual)
Tyre repair kit
Heavy duty tyre changer
Tachometer
Exhaust gas analyser
Lubrication equipment
Dynamometer
Cylinder boring machine
Steam cleaner
Diesel fuel pump test stand

Carburettor service kit
Chain wrench (for removing oil filter)
Portable vehicle hoist
Battery coil tester
Ignition coil tester
Snychroscope (distributor tester)
Spark plug tester
Pullers (various sizes)
Grease gun
Cylinder ridge remover
Engine sump drainer
Honing machine
Head light tester
Oil can
2 stroke diesel engines
4-cylinder diesel engine
6-cylinder petrol engine
Clutch testing machine
Life and dead vehicles
66 spanners of assorted types and sizes
Transparent engine and gear boxes (for demonstration)
Automotive engine test bed
Type K thermocouples for temperatures $0^{o}C$ -$1200^{o}C$
Steering geometry measuring device
Vibration meter
Electrolytic tester
Fuel consumption measuring system
Test rig for electric fuel injector (petrol)
Fire extinguishers, water, foam, dry powder and sand buckets
Wind tunnel
Flow visualization aerodynamics tunnel
Gas calorimeter
Steam power plant
Gas turbine

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.
NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, **Laboratories**, **Workshops**, **Clinics and Offices**

Academic and Non-Academic Spaces
The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	

Secretarial Space	7.00

Office Facilities

The requirements for office accommodation are:

1. 13 academic offices on paper
2. 1 professorial type in the department. Size: each of the office is about 13.5 m

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Biomedical Engineering

Overview

Biomedical Engineering applies physical science principles and engineering designs, concepts and problem-solving techniques to biology and medicine to improve healthcare. In biomedical engineering, many aspects of electrical engineering, mechanical engineering, chemical engineering, materials science and engineering, chemistry, mathematics and, computer science and engineering are integrated with human biology to improve human health. Biomedical engineering started as an interdisciplinary field and has grown into a multispecialty profession. A wide range of specialties and subspecialties currently exists in biomedical engineering. The major subspecialties include:

1. Bioengineering
2. Biomedical informatics
3. Bioprocess engineering
4. Biotechnology
5. Clinical engineering
6. Dental engineering
7. Medical engineering
8. Neural and regeneration engineering
9. Pharmaceutical engineering
10. Rehabilitation engineering

Philosophy

The philosophy of the training in biomedical engineering is to produce biomedical engineering graduates with high academic and ethical standards, and adequate practical exposure to solving societal problems in the areas of healthcare and social well-being.

Objectives

The objectives of biomedical engineering education and training are to:

1. conduct investigations into complex biomedical engineering problems;
2. design biomedical engineering projects, systems, machines and equipment, and supervise their implementation;
3. design and develop new products and production techniques in the biomedical industries;
4. install and maintain complex biomedical engineering systems for optimal performance in our environment;
5. adapt and adopt exogenous biomedical technology to solve local engineering/technical problems;
6. exercise original thoughts, have good professional judgments and take responsibility for executing essential tasks;
7. manage people, funds, materials, and equipment in the biomedical engineering industries;
8. be conversant with all the materials, components, machines, equipment, production techniques and systems in different specialties of biomedical engineering;
9. man and maintain specific production equipment in different areas of the biomedical engineering;
10. plan, manage, and be responsible for the quality control of biomedical engineering products and systems;

11. be proficient in using standards, codes, and modern information and communication technology tools in biomedical engineering practice;
12. have the ability to consider the human, social, environmental, and sustainability dimensions in finding solutions to complex biomedical engineering problems;
13. have a good knowledge of the ethics of the biomedical engineering profession and be able to apply the knowledge;
14. have the ability for independent and team work, especially for operating in a multidisciplinary and multispecialty team, and have good oral and written communication skills; and
15. to engage in lifelong learning for continuous self-improvement in the practice of biomedical engineering.

Employability Skills

Biomedical engineers are employed in various capacities according to their specialisations. There are currently about seven broad career prospects for every first degree graduate of biomedical engineering. These are outlined as follows:

1. The clinical area refers to the general, specialist, and teaching hospitals, federal medical centres, and other health centres where a biomedical engineer tackles day-to-day challenges in their professional career. Biomedical/clinical/ rehabilitation engineers work seriously in orthopaedic, psychiatric, general medicine clinics and specialist and teaching hospitals where they design, re-design, and maintain in-house medical equipment, and train medical personnel to use and operate medical devices. Biomedical informatics engineers can work in the medical records department of hospitals and clinics.
2. Still in the clinical area, some biomedical engineers also have advanced training in other fields. For example, some engineers also have MD degree and they combine an understanding of advanced technology with direct patient care and clinical research. They may also build customized devices for special healthcare or research needs.
3. Biomedical engineers supervise laboratory equipment in research and development establishments and, participate in or direct research activities with other researchers in medicine, physiology and nursing in many health-related research institutions. Some biomedical engineers are technical advisors in marketing departments of large biomedical companies and some are in management positions. Biomedical engineering research is ongoing in some medical science institutes, biotechnology outfits and other research institutes in Nigeria's Ministries of Health, Science and Technology, and Agriculture.
4. In Nigeria, universities, polytechnics, colleges, and schools of health technology train graduates in biomedical engineering who are awarded certificates, diplomas, bachelor degrees in science, engineering or technology, master's degrees in science and engineering and doctorates in in biomedical engineering and technology. Biomedical engineering graduates can function as academic and technical staff members in these areas – the academia.
5. Biomedical engineers create designs where in-depth understandings of living systems and technology are essential. They may be involved in performance testing of new or proposed biomedical products; design and redesign of proprietary and customised brands of biomedical devices; sales and marketing of biomedical devices and software development of medical apps in bio-IT industries. They can also be deployed as bio-engineers and tissue- engineers in the various chemical, food, pharmaceutical, biotechnology industries.
6. In ministries and other government agencies, biomedical engineers are often engaged as officers for product testing and safety officers who ascertain safety standards for devices in agencies like NAFDAC, NSO and the like. Biomedical engineers can be engaged to

formally certify and accredit professionals, professional societies and academic institutions as COREN does presently. They can also be employed in the Ministries of Health, Science, and Technology to undertake day-to-day implementation of government policies on biomedical engineering.

7. With the re-invigoration of entrepreneurship in the universities and its incorporation into all the undergraduate courses in biomedical engineering, graduates are prepared to become biomedical engineering entrepreneurs. In this case, biomedical engineers can start by undertaking medical equipment repairs and maintenance in hospitals where they had goodwill, while undertaking industrial training or serving the country under the National Youth Service Corps (NYSC). This, though, requires a level of technical skills, competencies as well as courage. Biomedical engineers can build their entrepreneurial skills through these efforts.

21st Century Skills

The 21st century skills includes:

1. creativity and innovation: the ability to create new ways of thinking and solve problems by being innovative;
2. critical thinking and problem-solving: the capacity to apply higher-order thinking to new problems and issues;
3. communication: the capability to communicate effectively in various forms and contexts for a wide range of purposes;
4. collaboration: the ability to work in teams to effectively generate, share and use ideas;
5. information literacy: the faculty to access, evaluate, synthesize and share information from multi-specialty/inter-disciplinary sources;
6. technology usage: the skill to identify appropriate technology tools and use them efficiently, ethically, and effectively;
7. career/life Skills: the ability to become independent and self-directed learners who can adapt to change, manage projects, take responsibility, lead others and produce results; and
8. personal/Social responsibility: the capacity to develop cultural competence in working with others and diverse cultural and social backgrounds.

Unique Features of the Programme

Some of the unique features of biomedical engineering are that it:

1. has a formidable influence on healthcare delivery;
2. employs the knowledge of modern biological principles in engineering design processes;
3. is a blend of science and technology that advances the healthcare industry;
4. often combines an aptitude for problem-solving and technical know-how focused on medicine, healthcare, and helping others; and
5. it is unique for its hybridisation which has led to innovations in healthcare delivery and the advancement of human well-being.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Discipline GET	Programme (BME)	SIWES Courses*	Total
100	4	16	3	2	-	25
200	4	-	14	8	3	29
300	4	-	10	10	4	24
400	-	-	-	10	8	10
500	-	-	5	15	-	20
Total	**12**	**16**	**32**	**45**	**(15)**	**105**

100 Level

Course Code.	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Practical Physics II				
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
CHM 101	General Chemistry I	2	C	45	-
CHM 107	General Practical Chemistry I	1	C	-	45
BIO 101	General Biology I	2	C	45	-
BIO 107	General Practical Biology I	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling	2	C	15	45
BME 102	Introduction to Biomedical engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code.	Course Title	Units	Status	LH	PH
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 209	Engineering Mathematics I	3	C	30	-
GET 211	Computer and Software Engineering	3	C	30	45
BME 214	General Biochemistry I	2	C	30	-
BME 215	Human Genetic I	2	C	30	-
BME 211	Human Anatomy I	2	C	30	-
BME 213	Human Physiology I	2	C	30	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**26**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analysis	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Language and Convergent Technologies	3	C	45	-
BME 334	Biomedical Instrumentation	2	E	30	-
BME 351	Biomaterials Engineering	2	E	30	-
BME 332	Biomedical Electronics	2	C	30	-
BME 316	General Pharmacology	2	C	30	-
*GET 399	SIWES I: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**20**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
BME 401	Biomedical Systems Analysis	2	C	30	-
BME 435	Biomedical Informatics	2	E	30	-
BME 453	Human Biotechnology	2	E	30	-
BME 461	Clinical Engineering	2	E	30	-
BME 481	Rehabilitation Engineering	2	E	30	-
*GET 499	SIWES II: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**2**			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I: SWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24weeks
	Total	**15**		

***All credited in second semester of 400 level**

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
BME 521	Biomedical Engineering Design	3	C	45	-
BME 526	Computer-Aided Design of Biomedical Systems	3	C	45	-

BME 522	Equipment Reliability and Safety Technology	3	C	45	-
BME 523	Biomedical Imaging Systems	3	C	45	-
BME 524	Biomedical Signal Processing	3	E	45	-
	Total	**17**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
1. identify and list the major linguistic groups in Nigeria;
2. explain the gradual evolution of Nigeria as a political entity;
3. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
4. enumerate the challenges of the Nigerian state regarding nation building;
5. analyse the role of the judiciary in upholding fundamental human rights
6. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
7. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I(Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates;

conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton’s law of gravitation, Kepler’s laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero’s law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;

3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

BIO 101: General Biology (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. explain the characteristics of living and non-living things;
2. outline the taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates;
3. describe the scientific methods to biology concepts;
4. explain the cell concepts, structure, organisation, functions, and chemical and physical characteristics; and
5. state the elements of biological chemistry, and of ecology and types of herb.

Course Contents

Characteristics of living and non-living things. Scientific methods to biology concepts. Taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates. Morphology and life cycles of phyla and plant kingdoms. Cell concepts, structure, organization, functions, and chemical and physical characteristics. Cells, tissues and organ systems, and organisms. Elements of biological chemistry – cellular metabolism - aspects of organic, inorganic and physical chemistry relevant to biology. Elements of ecology and types of habitats

BIO 107: General Practical Biology (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. conduct experiments on microscopes and microscopy;
2. conduct experiments on food test, enzyme activities, osmosis and diffusion;
3. identify and evaluate external morphology of the herbaceous plant, and cytological techniques;
4. make observations of experiments made; and
5. draw conclusions from experimental and numerical analysis of data.

Course Contents

Experiment on microscopes and microscopy, food test, enzyme activities, osmosis and diffusion, external morphology of the herbaceous plant and cytological techniques.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

BME 102: Introduction to Biomedical Enginering **(2 Units C: LH 30)**

Learning Outcomes

Students should, at the conclusion of the course:

1. know how fundamental physics, biological and chemical principles are applied to human body functions;
2. explain the impacts of technology on knowledge of biology, medicine and areas of general chemistry such as electronic configuration, atoms, chemical bonds, metals and non-metals, acids and bases, carbon and covalent bond and, water and its properties
3. know about cells, tissues, organs, and organisms; amino acids, proteins; carbohydrates; fatty acids and lipids; nucleic acids and nucleotides; genes and genetic information transcription and translation;
4. assess forces experienced by bones, joints, and muscles during exercise osteo-kinematics and arthro-kinematics; and
5. apply fundamental principles in physics, biology, and chemistry to human body functions.

Course Contents

Bio- and Medical Engineering: impacts of technology on biology and medicine. Biomedical engineering: definition, history, and components. Biomedical engineering, health technology, and human system: man, as a living machine; human system and instrumentation research, development, education, training, certification, and practice of biomedical engineering and health technology; problems and prospects of biomedical engineering and health technology in Nigeria and Africa.

200 Level

GST 212: Philosophy, Logic and Human Existence **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30, PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke’s and Green’s theorem;

5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and

4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of Programme-specific activities for their students.**

BME 211: Human Anatomy I **(2 Units C: LH 30))g**
Outomes
Learning Outcomes
Upon successful completion, students should be able to:
1. recognise and describe the major structures of the human body;
2. discuss the structural organisation and functions of each system of the human body;
3. apply their knowledge of human anatomy to solve questions regarding function and disease;
4. identify clinical scenarios, the concepts and knowledge of the general terminology, cell structure and function, histology, and gross anatomy of several organ systems (integumentary, skeletal, muscular, and nervous);
5. analyse and critically evaluate various sources of information related to these systems to discern reliable scientific information from unsourced information and pseudoscience;
6. demonstrate how human organ systems are interrelated, to apply a holistic approach to human health; and
7. develop research skills, including critical analysis, interpretation, synthesis, and communication of scientific data.

Course Contents
An overview of cell biology; tissue structures and human histology; basic structure of the human body; body planes and positions; the skeleton; regional anatomy of the upper limb, lower limb, thorax and abdomen.

BME 213: Human Physiology I **(2 Units C: LH 30)**

Learning Outcomes
Students should be able to:
1. demonstrate knowledge and understanding of terminology, concepts, and relationships in human anatomy and physiology;
2. utilise a broad foundation of anatomical relationships and physiological principles in analysis, application, and synthesis related to human physiology and pathophysiology;
3. evaluate scientific information to help make decisions concerning personal health, clinical applications, and research in human physiology;
4. describe how physiological parameters are measured in humans and animal preparations
5. achieve thorough insight into homeostatic mechanisms and the functions of the various organs and organ systems in humans;
6. interpret basic physiological data; and

7. apply the basic physiological principles explored to understand how their bodies work and carry that knowledge into their specific professional areas.

Course Contents
Basic concepts in Human physiology; cellular physiology; homeostasis; musculoskeletal system; Cardiovascular System; Respiratory System; Urinary System.

BME 214: General Biochemistry I (2 Units C: LH 30)

Learning Outcomes
Students should be able to:
1. demonstrate an understanding of fundamental biochemistry principles, including topics specific to chemistry and biochemistry;
2. explain the properties and biological functions of the major biomolecules;
3. locate, critically analyze, interpret and discuss data, hypotheses, results, theories, and explanations found in the primary literature;
4. design, carry out, and record the results of chemical and biochemical experiments using classical techniques, modern instruments, and computers, then analyze those results to draw reasonable, accurate conclusions;
5. communicate biochemical concepts and experimental results through effective written and oral communication; and
6. appreciate the structure and function of the main biochemical molecules (sugars, proteins, lipids, and nucleic acids), metabolic pathways of animal eukaryotic cells, and their regulation.

Course Contents
Review of general chemistry: chemical elements and the periodic table; electronic configuration, electronic orbital, valency of atoms, and types of chemical bonds; metals and non-metals; acids and bases, highlighting Lewis Conception; carbon, sp3 hybridization, the tetrahedron and covalent bond; functional groups; water and its special properties.
Introduction of the cell and hierarchy of organisation of living things: macromolecules, organelles, cells, tissues; organs, systems and organism.
Amino acids, proteins; the peptide bond and polypeptides; proteins as biological catalysts, immune agents and structural molecules.
Carbohydrates; the glycosidic bond; relationship of photosynthesis and tissue respiration; carbohydrate as storage molecule of easily accessible metabolic energy.
Fatty acids and lipids: the ester bond of lipids and triglycerides; fat as efficient energy storage molecule.
Nucleic acids and nucleotides: DNA and RNA as polymers of nucleotides; the phosphodiester bond; gene and genetic information transcription and translation.

BME 215: Human Genetic I (2 Units C: LH 30)

Learning Outcomes
Students should be able to:
1. exhibit a sound knowledge of basic genetics principles;
2. recognise important concepts related to human genetic diversity and inheritance;
3. identify the appropriate clinical applications of specific genetic techniques;
4. explain the basic concepts of human genetics as the basis of genetic engineering;
5. apply the simple technique of DNA fingerprinting;
6. discuss how these principles can be applied to fight disease; and
7. demonstrate the application of genetic engineering in fighting diseases.

Course Contents

Human Heredity: haploid and diploid chromosome, DNA, trait, genes, blood group. The Human Genome: Definition of Genome; History of Human Genome Project; Gene Sequencing; Molecular organization and gene content; Genetic Coding Genomic variation in humans. Genetic disorders: Albinism, Cystic Fibrosis, Dwarfism, Sickle Cell Disease, Color Blindness, Hemophilia, Duschenne Muscular dystrophy.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;

5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

.GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and

5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes
At the completion of the course, the students are expected to be able:
1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems;

understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

BME 316: General Pharmacology **(2 Units C: LH 30)**

Learning Outcomes
Students should be able to:
1. demonstrate an understanding of basic pharmacological principles and mechanism of action and classification of drugs;
2. describe fundamental concepts of drug-receptor interactions;
3. display an understanding of the processes involved in absorption, distribution, metabolism, and excretion of toxicants, including an understanding of the toxicokinetic behavior of toxicants in mammals;
4. identify molecular targets and pathways that are druggable and those for which there are already drugs available;
5. justify the main pharmacodynamic and pharmacokinetic principles and apply them to particular drugs;
6. integrate the principles of pharmacology in the process of drug evaluation (efficacy, safety, and quality); and
7. apply the principles of drug evaluation to specific situations: generics and biosimilar.

Course Contents
General Pharmacology: Historical development of pharmacology; divisions of pharmacology and their applications; definitions of terms and abbreviations: concept and nature of drugs. Pharmacodynamics; pharmacokinetics; classification of drugs and their importance. Drug abuse and control; drug noncompliance or misuse. Toxicology: Introduction to toxicology and its importance; general principles of poison managements.

BME 321: Human Biomechanics **(2 Units C: LH 30)**

Learning Outcomes
Upon successful completion of this course, students should be able to:
1. outline the principles of the study of human movement;
2. describe the range of factors that influence the initiation, production, and control of human movement;
3. define and list the types of forces and describe the relationship between forces and movement, body balance and control;
4. employ the role of biomechanics in the analysis of fitness activities such as strength, power, endurance, flexibility, and cardiovascular training;
5. locate the body's lever systems and their relationship to basic joint movement and classification;
6. demonstrate an understanding of kinetic concepts including inertia, force, torque, and impulse;
7. identify the major factors involved in the angular kinematics of human movement; and
8. apply biomechanics knowledge in tissues such as bone, ligaments, skeletal muscle, cardiac muscle, and cartilages.

Course Contents

Fundamental Principles of mechanics applied to study the physiology of biological systems. Introduction to the basic concepts of continuum mechanics-tensors, finite deformation kinematics, stress, conservation laws of mass, momentum and energy applied to deformable continua; rigid body kinematics in the context of applications in biomechanics.

Application of biomechanics in tissues such as bone, ligaments, skeletal muscle, cardiac muscle and cartilages. Skeletal muscle and mechanism of movement; biomechanical implications of the sliding filament theory; velocity-force curves; lever mechanics; types of muscle fibres.

BME 332: Biomedical Electronics (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. discuss the history of biomedical electronics;
2. describe standard biomedical electronic devices and systems;
3. explain necessary the precautions against hazards involved in electromedical devices;
4. acknowledge biomedical signals and their requirements for detection and processing;
5. identify and understand the required building blocks for a given biomedical system;
6. design circuits and systems for a given biomedical system specification; and
7. perform safety testing and troubleshooting of electromedical equipment.

Course Contents

General overview of biomedical electronics; history of biomedical electronics; biomedical electronics as composing of bioelectronics and medical electronics; intersection areas in biomedical electronics. Introduction to bioelectronics. Introduction to medical electronics. Study of common biomedical electronic equipment and systems such as thermometers, stethoscopes, pulse oximeters, patient monitors, telemetry systems, ambulatory systems. Hazards of electro-medical devices: physiological effects of electricity; tests and safety checks of medical devices; electrical safety testing. Troubleshooting of electro-medical equipment. Design of biomedical circuits. Computer applications in biology and medicine.

BME 334: Biomedical Instrumentation (2 Units E: LH 30)

Learning Outcomes

Students will have demonstrated the ability to:

1. explain the physical and medical principles of biomedical instrumentation;
2. describe different types of electrical medical equipment;
3. analyse and solve problems related to the design of biomedical measurement instruments;
4. describe the underlying physical phenomena, architecture, employed materials, operational modes device/instrumentation;
5. identify and use basic biomedical instrumentation;
6. classify medical instruments based on different principles with application viz - (diagnostic, therapeutic, Imaging, analytical), physiological parameter and biopotential, biological system, in other departments in the hospital;
7. illustrate the different types of medical transducers used in medical instruments for body temperature, blood pressure, and respiration rate; and
8. comprehend the physics of various biomedical transducers, such as electrodes, displacement transducers, thermocouples, thermistors, and flow meters.

Course Contents

Introduction to biomedical instrumentation: basic biomedical instrumentation system. General considerations in the design of biomedical instrumentation systems. Biomedical measurements: errors in measurement. Biological signals: bioelectric signals. Biomedical sensors and transducers-types and forms. Physiological measurements: audiology; cardiac physiology; gastrointestinal tract physiology; neurophysiology; ophthalmic and vision science; respiratory physiology; urodynamic physiology; vascular technology; blood pressure measurement; blood flow measurements; measurement of the respiratory system; ECG measurement systems.

Clinical laboratory instrumentation. Electrical safety in instrumentation. Introduction to Biomedical signal processing.

BME 351: Biomaterials Engineering (2 Units E: LH 30)

Learning Outcomes

Students should be able to:

1. comprehend biomaterials and tissue engineering terminology;
2. list different material types used in biomaterials and tissue engineering;
3. demonstrate a broad knowledge of materials science and engineering in biomedical applications;
4. examine physical properties, including degradation and mechanical properties of different kinds of biomaterials;
5. analyse biocompatibility and tissue-material interaction for different kinds of biomaterials;
6. determine the engineering properties of biomaterials;
7. apply the knowledge of engineering properties in the design of biomaterials for implants, prosthesis, and artificial organs;
8. explain what the application of biomaterials in biology and medicine means to biocompatibility and tissue-material interactions; and
9. ascertain what host response is to biomaterials and biomaterials failure.

Course Contents

Introduction to Engineering properties of biomaterials: fatigue of biomaterials applications of materials in medicine-cardiovascular, surgical, dental, ophthalmologic, orthopaedic applications.

Bioelectrodes and bio (medical) sensors. Artificial organs: heart, teeth, limbs and kidney.

Compatibility of biomaterials: tissue-material interactions; host response to biomaterials; biomaterials failure.

400 Level

BME 401: Biomedical System Analysis (2 Units C: LH 30)

Learning Outcomes

Students should be able to:

1. demonstrate the knowledge of the mathematical concepts applied in biomedical engineering, including linear relations and functions, systems of inequalities;
2. apply the best mathematical method for addressing a particular bioengineering problem;
3. formulate bioengineering problems in terms of appropriate mathematical modelling methods;
4. analyse biological data using appropriate mathematical methods;
5. evaluate the output of the mathematical modelling methods concerning the underlying biological processes;

6. manipulate experimental data using mathematical methods; and
7. assess the output of the mathematical analysis of a bioengineering problem.

Course Contents
Advanced mathematical concepts: linear relations and functions; systems of equations and inequalities; polar coordinates and complex numbers; exponential and logarithmic functions; iteration; statistics and data Analysis; limits, derivatives and integrals: applications of differentiation and integration. Mathematical methods and Models: numerical methods; finite differences; solutions of differential equations; role and application of models in biology and medicine. Computer simulations: Development of computer simulation techniques to study physiological system.

BME 435: Biomedical Informatics (2 Units E: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. apply knowledge and awareness of the basic principles and concepts of biology, computer science, and mathematics;
2. design, deploy and use the various electronic health information systems;
3. simulate biomedical systems experimentation and design with the aid of computer systems;
4. explore the massive biological data available and their manipulation with the computer systems;
5. utilise existing software effectively to extract information from large databases and to use this information in computer modeling; and
6. develop problem-solving skills, including the ability to develop new algorithms and analysis methods.

Course Contents
Introduction to biomedical informatics; components of biomedical informatics. Bioinformatics: What is bioinformatics; components of bioinformatics; biological data; information complexity; bioinformatics applications? Medical informatics: Management Information Systems in biology and medicine-data acquisition, data storage and retrieval, data processing; components of Health Information Systems; types of Health Information Systems. Computer networking in the hospitals: the concept of computer networking, telemetry; e-Health. Software development in biology and medicine. Computer applications in medical diagnosis and therapy. Computer-aided simulation and experimentation.

BME 453: Human Biotechnology (2 Units E: LH 30)

Learning Outcomes
Students should be able to:
1. apprehend the general principle and practice of biotechnology;
2. explain the structure and function of cell organelles and cellular transport;
3. describe the science of biotechnology and identify its product domains;
4. comprehend the concepts in human genetics and its applications;
5. identify the various natural and laboratory based modifications of DNA;
6. apply human biotechnology in solving human health problems;
7. use molecular biology techniques genetically engineer the animals to improve sustainability, productivity and suitability for pharmaceutical, agricultural and industrial applications; and

8. explain how scientific methodologies are used to conduct experiments and develop products.

Course Contents

Introduction to Biotechnology: Historical background; types, their examples and applications Biotechnology and human health: pharmaceuticals, diagnosis, vaccines, gene therapy, organ replacement therapy, nutrition, environmental health, health prevention, etc. Introduction to Genetic Engineering: history of genetic engineering; cloning; DNA fingerprinting; polymerase chain reaction; summary of DNA fingerprinting; application of GE in fighting diseases. Introduction to Tissue Engineering: basic biological concept– cells, organelles; tissue organisation; tissue dynamics, representative tissue; case studies; barriers to tissue engineering adoptions.

BME 461: Clinical Engineering (2 Units; E: LH 30)

Learning Outcomes

Students should be able to:

1. recognise the need and significance of technical support in hospital environments;
2. learn the basic skills for troubleshooting hospital equipment;
3. appreciate the challenges of technology management and its importance to good healthcare delivery;
4. design and implement the complete process of technology management;
5. conduct an economic analysis of medical technologies during acquisition processes (cost-benefit analysis);
6. facilitate a better understanding between biomedical engineers and medical doctors; and
7. acknowledge the role of clinical engineers in the healthcare environment.

Course Contents

Evolution of clinical engineering. The health care environment. Equipment planning. Clinical engineering education. Quality assurance. Equipment replacement project. The role of clinical engineering in hospital organisation and enhancing patient's safety. Healthcare facilities planning; A model clinical engineering department; careers, roles, and responsibilities of clinical engineers.

BME 481: Rehabilitation Engineering (2 Units E: LH 30)

Learning Outcomes

Upon completion of the subject, students should be able to:

1. apprehend the clinical fundamentals of injuries and dysfunctions;
2. recognise and apply fundamental knowledge of engineering in the rehabilitation of clients suffering from selected injury and body dysfunction;
3. use analytical skills to assess and evaluate the needs of the end-user requiring rehabilitation and assistive devices;
4. conduct patient/technology evaluation via the use of modern instrumentation;
5. apply rehabilitation engineering technology to help individuals with disabilities; and
6. appreciate safe working practices in rehabilitation engineering.

Course Contents

Introduction to rehabilitation engineering: technology and disability. Assistive technologies: implants, prostheses, and artificial organs in rehabilitation; Wheelchair and others. Rehabilitation robotics: aids for physically handicapped people. Rehabilitation in Special areas: Rehabilitation in Sports; Physiotherapeutic technologies; Psychiatric devices; orthopaedic devices, etc.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

BME 521: Biomedical Engineering Design (3 Units C: LH 45)

Learning Outcomes

Students should be able to:

1. employ techniques and tools for the design of biomedical equipment, including innovative ones;
2. utilise engineering tools and software to develop and communicate design concepts;

3. use appropriate standard guidelines to define design inputs for a biomedical device design;
4. explain the design process and use it to develop a design concept for problem-solving;
5. recognise the classical engineering design process;
6. apply the design process in the design of biomedical devices;
7. fabricate biomedical devices applying standard scientific methodologies; and
8. discuss the importance of ethics in biomedical engineering.

Course Contents

Overview of Engineering Design: classical steps in engineering design - identify the need, research the problem, develop possible solutions, select the most promising solution, construct a prototype, test and evaluate the prototype, communicate the design, and redesign. Biomedical Devices: Introduction to biomedical devices; overview of biomedical device design. Biomedical Engineering Design methodology: design tools; design (project) team management; the design process; project definition; project design specification; materials selection. Biomedical engineering manufacturing: prototyping in biomedical device design; testing and optimisation of biomedical design; product documentation; project presentation; manufacturing and quality control. Ethico-legal issues in Biomedical Engineering Design: intellectual property management; regulation of biomedical devices.

BME 522: Equipment Reliability and Safety Technology (3 Units C: LH 45)

Learning Outcomes

Students should be able to:
1. monitor equipment and assess its accuracy and reliability;
2. discern equipment reliability to equipment design;
3. employ all safety procedures to design and fabricate biomedical devices;
4. apply safety in the instrumentation of equipment; and
5. acknowledge quality assurance in equipment design.

Course Contents

Equipment reliability: Manufacturing and quality control; equipment (project) reliability; equipment maintainability and availability. Equipment safety: Safety consideration in equipment design – reliable equipment earthing reduction of leakage current and operation at low voltage. Safe instrumentation: Physiological effects of electricity, shock hazards, electrical safety codes and standards, power distribution protection, electric system testing.
Quality assurance in equipment design.

BME 523: Biomedical Imaging Systems (3 Units C: LH 45)

Learning Outcomes

The student should be able to:
1. describe the relevant basic methods in applied medical image processing;
2. develop an understanding of biomedical imaging instruments to measure signals from biological systems.
3. appreciate the fundamental principles of advanced imaging concepts in fluorescence and nanoscale imaging to study molecular dynamics in living cells;
4. analyse and compare imaging systems for different biological levels: organs, tissues, cells, and molecules, justifying the pros and cons of each technique;
5. critique the design factors that contribute to the construction of advanced bioimaging systems with numerical calculations and physical concepts;

6. design and realise image processing algorithms for a range of applications, including noise cancellation, filtering, segmentation, and rendering;
7. demonstrate their knowledge of characteristics and applications of X-Rays, CT, NMRI, and ultrasound technology; and
8. apply the knowledge of biomedical imaging in medical therapy and rehabilitation.

Course Contents
Introduction to Radiation: review of physical concepts of radiation-atomic and nuclear structures, electromagnetic spectrum, x-ray production, radioactive decay; ionizing and non-ionizing radiation; X-ray interaction. Radiation & Imaging Systems: X-rays - characteristics and applications; computerized tomography; technology and applications; gamma camera; nuclear magnetic resonance imaging; systems and applications; ultrasound imaging. Basic radiobiology: radiation dosimetry and protection; Legislation and regulations for radiation protection.

BME 524: Biomedical Signal Processing (3 Units E: LH 45)

Learning Outcomes
Upon completion of the subject, students should be able to:
1. extract useful information from a biomedical signal;
2. demonstrate an understanding of signal representation and processing across a range of biomedical devices;
3. apply advanced knowledge in biomedical image processing to develop and implement biomedical algorithms for processing biomedical images and critically interpret their success;
4. appreciate the mathematical principles of continuous and digital signal processing;
5. apply specific mathematical techniques to solve problems in the area of biomedical signals; and
6. describe the origin, properties, and suitable models of important biological signals such as ECG, EEG.

Course Contents
Signals: What is a signal? History; categories; application fields. Biomedical Signals: nature, sources, types and examples. Signal Processing: Definition, Stochastic and deterministic signals, Discrete signals, Linear time invariant systems, Duality of time and frequency domain, Hypotheses testing. Biomedical signal Processing: Brain signals-local field potentials (LFP), electrocorticogram, (ECG), electroencephalogram (EEG), and magnetoencephalogram (MEG); Heart signals - Electrocardiogram, Heart rate variability, Fetal ECG; Electromyogram; Gastro-intestinal signals; Acoustic signals. Modeling Biomedical Systems.

BME 526: Computer-Aided Design of Biomedical Systems (3 Units C: LH 45)

Learning Outcomes
Students should be able to:
1. apply the computer to generate a graphical representation of the human body;
2. use the medium of drawing in engineering communications;
3. describe the general principles involved in the use of engineering drawing;
4. demonstrate skills in computer-aided draughting to produce detailed 2D and 3Ddrawings;
5. design biomedical engineering products using CAD tools, with engineering drawings as the medium of effective communication;

6. demonstrate skills in interpreting and producing engineering drawing accurately and efficiently; and
7. comprehend the applications of CAD in medical imaging, diagnosis of diseases, etc.

Course Contents
Computer Aided Design (CAD): Introduction; basic principles of CAD; CAD hardware and software; the drawing tools; design management; introduction to 3-dimensional (3-D) design; 3D modeling; the printing and plotting process. Design of biomedical systems: Use of CAD in the design of medical equipment. Practical applications - Biomedical applications of CAD: applications in medical imaging; applications in medical diagnosis of various diseases e.g. lung diseases, breast cancer, stroke, sleep disorder, epilepsy, liver cancer, microcalcifications, and artery disease.

Minimum Academic Standards

Equipment

The professional skills necessary to practise biomedical engineering can be acquired first and foremost from the training using institutional facilities designed and equipped to stimulate the practice of the profession. It should, therefore, be adequate in quality and quantity.The number of laboratories each department has will depend on the number of biomedical engineering specialty options offered. As an example:

1. A-one- option department is expected to have one standard multi-specialty workshop and one standard inter-disciplinary laboratory.
2. A two- option department is expected to have one standard multi-specialty workshop and two standard specialty laboratories (reflecting the two options).
3. A three- option department is expected to have one standard multi-specialty workshop and three standard specialty laboratories (reflecting the three options).

List of Workshops/Laboratories/Equipment/Instruments/Tools

General Biomedical Engineering Workshop
1. Lathe machine;
2. Hand tools;
3. Drilling machine;
4. Hand machine;
5. Grinding machine;
6. Folding machine;
7. Work tables and table vices;
8. Standard toolbox for mechanics, electricians and biomedics;
9. Gas and arc welding machines and accessories, and casting facilities;
10. Saw: hack, radial, circular, panel, rip - blade diametre- 400mm with external blades;
11. Marking gauge;
12. Chisel: dicferent sets;
13. Clamp: C-, F- etc;
14. Extra knives carpentry machine planner and thicknesser;
15. Air compressor – for spraying; tank capacity 500 litres complete with accessories - type spray gun and air blow-gun;
16. Battery: tester, charger and service equipment

Bioengineering/Biotechnology Laboratory Bioinstrumentation Unit
1. CFX96 real-time PCR;
2. Protein/nucleic acid electrophoresis system;
3. UV/VIS spectrophotometre with nanovette;
4. Differential scanning calorimetre (DSC);
5. Semi-dry blotting system with power supply;
6. Impedance aAnalyseAnalyser system with PC;
7. Wet blotting system;
8. Molecular imager;
9. Analog/digital multimetre;
10. Signal generator;
11. Multiple input oscilloscopes; and
12. Relevant analysis software and hardware

Biorheology Unit
1. Spectrophotometre;
2. Turbid, pH metre;
3. Conductivity metre, colourimetre;
4. Digital rotary, viscometre, thermogravimetric aAnalyseAnalyser;
5. Digital thermometre (-50 - 1000°C) with asphalt needle probe 3 comm long;
6. Ion chromatograph equipment;
7. Solid/liquid extraction unit (complete);
8. Filtration unit with plate and frame filter unit Ffuid bed dryer, digital;
9. Film and dropwise equipment;
10. Fractional distillation column;
11. Laboratory scale spray dryer;
12. Distillation column (computer interfaced distillation column);
13. Water bath;
14. Autoclave; and
15. Centrifuge.

Biomedical Informatics Laboratory
Digital Unit
1. Digital oscilloscope;
2. Logical circuit EX board A, B;
3. Logic tutor EX board;
4. Basic electrical and electronic application EX board B;
5. Digital system;
6. Project board; and
7. Digital data formatting

Computer Networks Unit
1. TCP/IP trainer kit;
2. Licensed software, e.g., OPNET, NS2, assembler, multiSim MATLAB and so on;
3. Networking accessories, e.g., UTP cable, socket, splitter, patch panels, reuters/switches; and
4. Database management software (MySQL)

Software Development Unit
1. Sufficient number of desktop computers with appropriately licensed software packages installed in them.

Modeling and Simulation Laboratory
1. High-Performance Server
2. Workstations
3. Software licenses-fluent, comsol, etc
4. Routers
5. Switches
6. Servers
7. Large format printer

Computer-Aided Design Unit
1. Computation tool on finite elements such as CATIA; NASTRAN; ABAQUS; IDEAS;
2. MATLAB; ANSYS, PDMS;
3. Workstations (at least one (1) workstation to five (5) students);
4. Printer;
5. Multimedia facilities;
6. Most importantly, the laboratory is expected to install software packages such as AutoCAD for drawing and other specialised packages for virtual laboratory.

Computer-Aided Manufacture
1. CNC machines (lathe, milling, drilling, etc)

Bioprocess Engineering Laboratory

Bioinstrumentation Unit Equipment
1. CFX96 real-time PCR;
2. Protein electrophoresis system;
3. UV/VIS spectrophotometre with nanovette;
4. Nucleic acids electrophoresis system;
5. Differential scanning calorimetre (DSC);
6. Wet/semi-dry blotting system with power supply;
7. Impedance Analyseanalyser system with PC;
8. Impedance Analyseanalyser system with PC;
9. CO_2 incubator;
10. Molecular imager;
11. Analog/digital voltmetre;
12. Signal generator;
13. Multiple input oscilloscopes; and
14. Relevant analysis software and hardware.

Clinical Engineering/Medical Engineering/Dental Engineering

Instrumentation Laboratory
1. Control and instrumentation principles(FULL KIT);
2. Analogue andand digital control board;
3. Transducers kit: electromechanical, heat, light, etc;
4. Measurement equipment;
5. Precision Modular Servo Control System;
6. Input/Output Potentiometre Unit;
7. Operational Amplifier Unit;
8. Power supply unit;
9. Function/signal generators;
10. Software upgrade to MATLAB 7.XX;

11. NI: cable assembly, interface card;
12. PID unit;
13. Wattmetre;
14. Transfer function analyser;
15. Logic probe /pulser;
16. Resistance /capacitance box

Control Laboratory
1. Process control simulation apparatus
2. Pressure control apparatus

Digital Unit
1. Digital logic analyseanalyser
2. Smart logic design experimental kit
3. Digital logic circuit design experiment kit microcomputer trainer
4. AM/FM transmitters and receivers system trainer
5. Programmable logic controller system trainer
6. Analog/digital storage colour display 2/4-channel oscilloscope
7. Arbitrary waveform and Digital Synthesized function Generator
8. Digital spectrum Analyseanalyser (9kHz -3GHz)
9. Instrumentation trainer using transducers complete set
10. Analog/digital communication system trainer
11. Electrical and electronic system trainer
12. Power electronic training system
13. Training kit universal EPROM programmable (48 pins)
14. Bench digital multi-metre digit (various digit ranges)
15. Advanced frequency modulation and demodulation train
16. Decade box: resistance, capacitance, inductance
17. Photo/contact tachometre
18. Portable DC potentiometre
19. PCB Fabrication equipment complete set

Fluid Mechanics Unit
1. Manometres
2. Apparatus for hydrostatic forces on plane and curved surfaces
3. Forced vortex apparatus
4. Stability of floating bodies
5. Hydraulic test benches
6. Apparatus for head losses in pipe fittings
7. Apparatus for the flow of fluid around bodies
8. Hydraulic power circuitory and measurement units
9. Centrifugal pump system
10. Calibration and performance of flow measurement devices

Neural, Regeneration, and Rehabilitation Engineering

Biomechanics Unit
1. Cleve lab virtual instruments
2. Human arm model with angle sensors
3. Gonoimetre(probe + velero straps)
4. Conductivity sensor and dissolved oxygen
5. Respiration rate sensors

6. Bicycle ergometre

Tissue and Regeneration Medicine Unit

Equipment (Cell Culture Lab)
1. Biosafety (laminar flow hoods) cabinet Type All with stands
2. Incubators
3. Inverted microscopes with digital cameras and PC + cell counting sets
4. Orbital shaker, vortexer, water baths, pH metre, micropipettes, balance
5. Nano ure water system, autoclave liquid N2 storage, microplate reader, and - 80 freezer
6. Protein eectrophoresis system
7. Nucleic acids electrophoresis system
8. Cryotome
9. Lab fluoroscopic imaging microscopes
10. Support equipment employed in cell culture and Analysis

Pharmaceutical Engineering
1. Automated biochemical Analyseanalyser
2. Automated cell counter
3. Cell harvesting system
4. Gel electrophoresis instrument
5. Flow cytometry
6. Gas chromatograph mass spectrometre / GC MS instrument

PCR Technology
1. DNA thermal cycler / PCR instrument
2. Gradient PCR machine
3. PCR workstation / PCR cabinet
4. PH transmitter
5. Pharmaceutical tablet testing equipment
6. Disintegration tester /disintegration apparatus
7. Dissolution media preparation system
8. Dissolution sampler/issolution sampling system
9. Electrophysiology equipment
10. Portable laboratory equipment/field testing equipment
11. Handheld XRF Analyseanalyser
12. Portable balances.

Staffing
Academic Staff
The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
There should be:
1. a section for biomedical engineering books, journals and other resource materials in the University library;
2. an electronic library section with some online databases relevant to the biomedical engineering degree programme in the University library;
3. a departmental library with books journals, and other resource materials for biomedical engineering.

Classrooms, Laboratories,Workshops, Clinics and Offices
The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00

Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

1. At least three (3) adequate and dedicated classrooms;
2. Two (2) lecture theatres;
3. Two (2) laboratories and one (1) biomedical engineering workshop;
4. One (1) affiliated hospital clinic;
5. Four (4) senior lecturers', three (3) other lecturers', two (2) technologists', one (1) technician's, and one (1) administrative offices are the minimum required.

B.Eng. Chemical Engineering

Overview

The B.Eng. Chemical Engineering Core Curriculum and Minimum Academic Standards (CCMAS) is the new curriculum approved by the National Universities Commission (NUC) for use in all Nigerian universities for the educational training of chemical engineers. It is the efforts of all the universities in Nigeria and experts who worked together to develop it. It is an improvement over the B.Eng. Chemical engineering Benchmark Minimum Academic Standards (BMAS), which was in use from 2007 until the approval of the present CCMAS. The B.Eng. Chemical Engineering CCMAS compares significantly well with any B.Eng. as this CCMAS provides a unique basis upon which specialisation and uniqueness of individual institution can be built.

The aim is to produce graduates that meet the needs of today's process industries by providing a thorough understanding of the subject, technical competence, and transferable skills required for the 21st Century knowledge-based and digital economy. The B.Eng Chemical Engineering CCMAS contains 105 Units of core courses in Basic Sciences, General Engineering and Chemical Engineering Sciences. The course content for all the courses as well as learning outcomes for individual courses in the CCMAS are outlined as a guide for content delivery. The balance of the 150 units required for graduation are to be designed by the University to suit its purpose. The aim is to produce Chemical Engineers with generic skills, competencies and attitudes fit for the 21st Century and the 4th Industrial Revolution.

Philosophy

The general philosophy of the Chemical Engineering CCMAS is to produce graduates with high academic and soft skills competence, capable to adequately participate, transform, impact on the engineering and allied industries in consonance with National and Global community values, including National Policy on Industrialisation and Self-Reliance.
Chemical Engineering is a very diverse profession that finds application in many knowledge areas such as science, technology, finance, management and ICT. In Science, there are applications in areas from Biology to Chemistry and Mathematics and Engineering Science. The skills needed in process industries even in cutting edge ones such as Environment, Biotechnology, Nanotechnology, etc. are found in chemical engineers. These industries depend on chemical engineers to make their products and processes a reality. Hence an appropriate CCMAS must establish a broad knowledge base upon which the required skills can be built. This begins with foundational knowledge in chemistry, biology, physics, and mathematics. From this foundation, a core expertise in engineering is developed in areas such as thermodynamics, transfer and separation processes, chemical reaction, process modelling and simulation. To be equipped for the challenges of the 21st Century complex and real-national and world problems, chemical engineers must develop engineering problem-solving skills, strong synthetic and analytical skills. The modern-day chemical engineer must thus find relevance in the application of these knowledge and skills to create innovative solutions to the 21st Century industrial and societal problems in areas such as environmental responsibilities, clean energy sources, sustainable system, and discovery, processing and production of new materials and products.

Objectives

The objectives of the programme are, amongst others, to:

1. apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the solution of Chemical Engineering related problems;

2. design solutions for Chemical Engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, environmental and other ethical considerations;
3. conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;
4. create, select and apply appropriate techniques, resources and modern engineering and IT tools: including prediction and modeling, to complex engineering activities, with an understanding of the limitations;
5. function effectively both as an individual and as a team member or leader in diverse and in multi-disciplinary settings;
6. communicate effectively on complex engineering activities with the engineering community and with society at large;
7. apply the knowledge and understanding of engineering and management principles in managing multi-disciplinary projects;
8. create awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
9. develop entrepreneurial skills and knowledge, in addition to adequate training in human and organisational with a spirit of self-reliance so that they can set up their own businesses.

Unique Features of the Programmme

There are a number of features that characterise the CCMAS curriculum:

1. more student-directed learning;
2. limitation of classroom contact time by minimising student work load;
3. increased application of computer and computer software in both teaching and learning;
4. early introduction into Engineering discipline and Chemical Engineering;
5. development of creative and innovative skills;
6. development of entrepreneurial skill;
7. specialisation to define uniqueness of programme; and
8. provision for combination with emerging and cutting-edge technologies.

Employability Skills

A Chemical Engineer to be able to function adequately in the 21st century national and global industrial, economic and societal environment must possess certain skills such as:

1. application of Fundamental and Specialist knowledge;
2. engineering Design;
3. investigations, experiments and data analysis;
4. engineering methods, skills, tools and information technology;
5. professional and technical communication;
6. impact of Engineering activity;
7. individual, team and multi-disciplinary working;
8. independent learning ability;
9. responsibility for Decisions;
10. management of Engineering Activities;
11. professionalism; and
12. effective Communication.

21st Century Skills

The B.Eng. Chemical Engineering CCMAS has the capability of inculcating into the graduate engineers skills essential for the 4th industrial revolution such as:

1. problem solving skills;
2. computing and data management skills;
3. modelling and simulation skills;
4. information and Communication skills;
5. Self-reliance and ability to take initiative;
6. critical, innovative and creative thinking abilities;
7. collaborative and team-working skills;
8. leadership skills and responsibility; and
9. analysis, interpretation and synthesis of information.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the courses registered for, including all compulsory courses and such elective and optional courses as may be specified by the university/faculty or department and obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.

5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Year	**GST**	**ENT**	**Basic Science**	**General Enginering**	**Chemical Engineering**	**SIWES**	**Total**
1	4	-	16	3	2	-	25
2	2	2		17	3	3	29
3	2	2	-	7	12	4	25
4	-		-	-	5	8	13
5	-		-	5	8	-	13
Total	**8**	**4**	**16**	**32**	**30**	**15**	**105**

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
TCH 101	Introduction to Chemical Engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 204	Students Workshop Experience	2	C		90
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
TCH 201	Chemical Engineering Fundamentals	3	C	45	-
TCH 202	Material Science	3	E	45	-
TCH 206	Statistics for Chemical Engineers	2	C	30	
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**26**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	
ENT 312	Venture and Creation	2	C	15	45
GET 304	Technical Writing and Communication	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	2	C	30	-
TCH 301	Transfer Processes I	2	C	15	TUT 15
TCH 302	Chemical Engineering Thermodynamics	2	C	30	
TCH 303	Separation Processes I	2	E	30	
TCH 304	Process Instrumentation	2	E	30	
TCH 305	Chemical Engineering Laboratories I	1	C	-	45
TCH 307	Biochemical Engineering	2	C	30	
TCH 308	Numerical Methods in Chemical Engineering	2	C	30	

*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks
	Total	**21**		

400 Level

Course Code	Course Title	Units	Status	LH	PH
TCH 401	Chemical Product Design	3	C	15	90
TCH 402	Chemical Reaction Engineering I	3	E	45	-
TCH 404	Plant Design and Economics	3	E	15	90
TCH 405	Process Control	2	E	30	-
TCH 406	Process Modelling and Simulation	2	C	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**5**			

* **Student Industrial Work Experience Scheme (SIWES)**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I: *SWEP*	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24 weeks
Total		**15**		

*All credited in second semester 0f 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TCH 501	Plant Design II	4	C	15	135
TCH 555	Chemical Engineering Research Project	4	C	-	180
	Total	**13**			

RECOMMENDATION: TCH 555 – Chemical Engineering Research Project be taken/taught over the two semesters of the final year.

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;

5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC) Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids

and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents
(Pre-requisite –MTH 101)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

TCH 101: Introduction to Chemical Engineering **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. appreciate the role of the chemical engineer in the industry and society;
2. be able to use basic engineering units in both SI and imperial systems in solving problems;
3. develop problem solving skills and engage more effectively in solving different types of problems;
4. formulate and solve basic steady state material balances for single units; and
5. perform stoichiometry analysis for chemical conversions and apply it to material balance.

Course Contents

The role of the chemical engineer. Units and dimensions. The mole unit. Conventions in the method of analysis and measurement. Temperature. Pressure. Physical and chemical properties and measurement. Techniques of solving problems. The chemical equation stoichiometry, material balances in single units, recycle, bypass, purge. This course will be supported with guest lectures from senior chemical engineers in industries, government and academia.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and

7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and

4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

TCH 201: Chemical Engineering Fundamentals (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. formulate and solve closed steady state material balances on multi-stage systems with and without a recycle and purge;
2. formulate and solve closed steady state Material balances on multi-stage systems that include single and multiple chemical reactions;
3. formulate and solve closed steady state material balances on multi-stage systems that include complete and incomplete conversions;
4. formulate and solve problems involving species and elements for reacting and non-reacting systems;
5. formulate and solve energy balances; and
6. formulate and solve combined material and energy balances.

Course Contents
Analysis of material balances for multiple systems. Analysis of material balances problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving species and elements for reacting and non-reacting systems. Material balances in process flow sheets. Energy balances procedures; energy balances for reactive and non-reactive processes; combined mass and energy systems. Computer aided balance calculations.

TCH 202: Material Science (3 Units E: LH 45)

Learning outcome
On completion students should be able to:
1. explain the basic concepts and mechanism of atomic structure, configuration, inter-atomic bonding, crystals and microstructure;
2. explain/discuss the relationship between structure and properties of materials;
3. explain the characteristics of phase diagrams and phase transformations of solid solutions (alloys);
4. determine the components and compositions of phase diagrams and phase transformations of solid solutions (alloys);
5. discuss the different types, causes and effects of corrosion and methods of its prevention and mitigation; and

6. discuss the basic principles of nanotechnology, nanomaterials and engineering applications.

Course Contents
Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramics and polymers. Principles of the behaviour of materials in common environments. Phase diagrams and phase transformations of metal solutions. Effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Corrosion: types, causes and effects of corrosion, corrosion prevention and mitigation. Fabrication processes and applications. Basic nanotechnology, nanomaterials and engineering applications.

TCH 206: Statistics for Chemical Engineers (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. construct appropriate graphical displays of data and understand the role of such displays in data analysis;
2. perform statistical inference tasks using software and understand the calculations involved in such tasks and be aware of assumptions necessary for the validity of results;
3. use and interpret statistical software package such as MINITAB, Design Expert to summarise and analyse industry data;
4. make appropriate conclusions based on experimental results;
5. plan and execute an experimental program to determine the performance of a chemical engineering system;
6. evaluate the accuracy of the measurements taken; and
7. communicate the results of the investigation in a number of ways.

Course Contents
Chemical engineers must have an appreciation of the accuracy and reliability of measurements. This course provides a broad introductory knowledge of statistical techniques used in data analysis. It also seeks to link the measurement of various quantities with statistics to enable the analysis of the accuracy of the measurements. Statistical inference intervals, tests hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Students to have weekly or fortnightly computer laboratory-based assignments.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching).

Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 306: Renewable Energy Systems and Technology (3 units C: LH 30 PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; trans-esterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;

b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

TCH 301: Transfer Processes I **(2 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of the course, students should be able to:

1. derive the heat diffusion equation and use it to predict temperature profiles across solid bodies transferring heat by conduction;
2. derive equations of heat transfer by convection and use them to predict the rate of heat loss under steady state natural and forced convection;
3. derive the equations of heat loss by radiation, and use them to predict the rate of heat loss under steady state conditions;
4. perform a procedural design of a heat exchanger for defined process requirements;
5. derive equations of mass transfer by molecular diffusion and use these to predict the flow rates and composition of output streams from a mass transfer operation under steady state conditions;
6. determine the performance and size of a given heat exchanger using different methods; and
7. perform pressure drop calculations and procedural design of different heat exchangers according to defined process requirements.

Course Contents

Steady State Conduction. Forced and Natural Convection. Reynolds' Analogy. Heat Transfer Film Coefficient Correlations. LMTD Heat Transfer Design. Fouling Factors. Radiation; Blackbody Radiation, Emission from Real Surfaces. Kirchoff's Law. Unsteady-State Conduction. 2-D Conduction. Fundamentals of Mass Transfer. Similarity of Momentum, Heat and Mass Transfer. Convective Mass Transfer. General, Molecular and Turbulent Diffusion Equations. Fick's Law for Diffusion. Molecular Diffusion in Gases, Liquids and Solids. Diffusion Coefficients in Gases. Liquids. Shell and Tube Heat Exchangers. LMTD Correction Factors. Heat Transfer and Pressure Drop Correlations. HX Design and Performance (Kern's and NTU Methods for Multipass and Cross-Flow HX). Compact Heat Exchangers. Plate Heat Exchangers.Operating Principles, Series and Parallel Combination, Use and Limitations. Comparison with Shell and Tube Heat Exchangers.

TCH 302: Chemical Engineering Thermodynamics I **(2 Units C: LH 30)**

Learning outcomes

At the end of this course, the students should be able to:

1. perform calculations for various heat effects on industrial reactions as functions of temperature and with or without phase change;
2. use enthalpy-concentration and related diagrams in the analysis of heat effect on industrial reactions;
3. perform calculations of equilibrium constants of reversible reactions; and
4. perform calculations on the effect of temperature and pressure on equilibrium constants and conversions for gas phase, liquid phase and heterogeneous reactions.

Course Contents

Heat Effects. Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clasius-Clapeyron equation, standard heats of reaction, formation and combustion effect of temperature on heat reaction. Heat of

mixing and solution, Enthalpy concentration diagrams for H_2SO_4, H_2O, etc., partial enthalpies.
Chemical Reaction Equilibria; Standard free energy change and equilibrium constant, Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; calculation of conversion; Gas phase reactions, Percentage conversion; Liquid phase reaction Heterogeneous reactions.

TCH 303: Separation Processes I (2 Units E: LH 15; PH 45)

Learning outcomes
At the end of this course, the students should be able to:

1. identify, analyze and solve engineering problems involving phase separation;
2. estimate stage requirements for absorption, stripping, and liquid-liquid extraction systems; and
3. estimate the number of stages, feed plate, product rates, reflux ratios for binary distillation systems using mccabe-thiele, ponchon-savarit methods.

Course Contents
Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation, flash distillation; distillation systems - types of condensers and reboilers, plate versus packed columns, reflux ratio, Distillation of binary mixture - McCabe Thiele method: rectifying and stripping section, feed plate; Ponchon-Savarit method.

TCH 304: Process Instrumentation (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the principles of various flow, temperature, pressure and liquid level measurements;
2. explain the principles of some analytical instruments use in physical and chemical characterisation of materials;
3. identify appropriate instruments applicable for particular characterisation; and
4. interpret and analyse data obtained from analytical instruments.

Course Contents
Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems. Description and use of current instrumentation such as atomic spectroscopy, infra-Red spectroscopy, High Performance Liquid Chromatography, Scanning Electron Microscope (SEM)

TCH 305: Chemical Engineering Laboratory I (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. locate (or identify) relevant literature sources to support/contradict theoretical arguments, and to find data;
2. demonstrate theoretical principles by means of experiments;
3. propose theoretical models of experimental data; or
4. evaluate the accuracy of prescribed theoretical models; and

5. communicate (or describe) technical information and arguments in a professional manner.

Course Contents
Laboratory experiments in transport phenomena. Kinetics and separation process

TCH 307: Biochemical Engineering (2 Units C: LH 30)

Learning outcomes
At the end of this course, the students should be able to:
1. explain the basic concepts of macromolecules and their building blocks, and their relevance to chemical engineering;
2. interpret the fundamental of microbial growth, the principles of enzyme and cell kinetics;
3. calculate cell growth, and enzyme kinetics; and
4. perform mass balance on cell and enzyme systems

Course Contents
Introduction to microbiology and biochemistry. Classification and growth characteristics of micro-organisms. Enzymes Engineering: including enzyme kinetics, aerobic and anaerobic respirations, metabolic pathways, cell growth kinetics and models

TCH 308: Numerical Methods in Chemical Engineering (2 Units C: LH 30)

Learning outcomes
At the end of this course, the students should be able to:
1. apply numerical method techniques to solve problems arising from heat and mass transfer, chemical reactions, thermodynamics, fluid mechanics and molecular simulations;
2. apply numerical method techniques to solve different categories of mathematical equations;
3. apply numerical methods such as navier-stokes, runge kutta, newton-raphson, taylor's series etc to solve ODES and PDES; and
4. perform numerical integrations and differentiation.

Course Contents
Numerical methods for solving problems arising in heat and mass transfer, fluid mechanics, chemical reaction engineering, and molecular simulation. Topics: numerical linear algebra, solution of nonlinear algebraic equations and ordinary differential equations, solution of partial differential equations (e.g., Navier-Stokes), numerical methods in molecular simulation (dynamics, geometry optimization). Runge Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation. All methods are presented within the context of chemical engineering problems.

400 Level

TCH 401: Chemical Product Design (3 Units C: LH 15; PH 90)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify a chemical process or product that is of relevance and of value that will involve application of student knowledge of chemical engineering principles;

2. develop a strategy for the design and production of this process/product including milestones;
3. develop the project budget and market analysis of the process/product;
2. write a proposal for the development/production of the process or product;
3. apply principles of starting up a chemical engineering business successfully;
4. Package the product for market where possible; and
5. Present process orally and in writing.

Course Contents

Chemical Engineering open-ended problems/projects that require students to design a chemical process or product. Each team generates and filters ideas; identifies use cases and objectives; evaluates and selects a design strategy; develops a project budget; schedules milestones and tasks; and writes a proposal with supporting documentation. Each project must meet specified requirements for societal impact, budget, duration, person hours, environmental impact, safety, and ethics. Principles of chemical engineering business start-ups.

TCH 402: Chemical Reaction Engineering I (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. calculate conversion in batch and flow systems;
2. size single batch, continuous-stirred tank, and plug flow reactors;
3. size real reactors in different flow regimes, packed bed reactors catalytic reactors and unsteady state reactors;
4. identify and determine the parameters in kinetic rate expressions for homogeneous reactions;
5. maximise product selectivity for systems involving multiple reactions;
6. use residence time distributions to find conversions for non-ideal mixing; and
7. use computer software packages to assist in sizing reactors.

Course Contents

Introduction to chemical kinetics; concentration versus time equations for single, irreversible reactions; concentration versus time equations for reversible reaction; design of the ideal PFR, CSTR; batch and semi-batch reactors and CSTRs in series.
Real tubular reactors in laminar flow; Real tubular reactors in turbulent flow; packed bed reactors; unsteady reactors; residence time distribution functions for non-ideal flow reactors.

TCH 404: Plant Design and Economics (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. calculate stream data and present on a process flow-sheet from process descriptions;
2. explain the general principles of design, the techniques specific to particular products and processes and the characteristics of engineering materials and components;
3. prepare and present findings of engineering design tasks;
4. plan and produce process flow sheet for a specified industry or product;
5. perform mechanical design of process units and piping;
6. perform basic costing and economic evaluation of process units and systems; and
7. use CAD software to perform design activities.

Course Contents

Presentation and discussion of real process design problems; sources of design data; process and engineering flow diagram; process outline charts incorporating method study and critical examination; mechanical design of process vessels and piping. Environmental considerations site considerations; process services. Costing of design Process. Formulation of feasibility report evaluation. Economics and safety consideration must be stresses. Computer aided Design; application of software packages in design.

TCH 405: Process Control (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be albe to:

1. explain the importance of process control in chemical engineering industry and classify chemical process variables;
2. solve first order and second order ODE's analytically and using Laplace transform;
3. determine the transfer function of chemical processes; and
4. determine the stability of chemical processes from their transfer function.

Course Contents

Process dynamics. Transfer functions. Frequency response analysis. Discrete events. Control system design. Cascade control. Feed forward and feedback control. Introduction to multi-variable control. The control valves.

TCH 406: Process Modelling and Simulation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. generate and solve mathematical models involving chemical process systems such as transfer processes, separation processes, chemical reactions and thermodynamics;
2. use appropriate software to simulate various aspects of process systems including but not limited to flow sheets, vessels, piping, instrumentations, etc.;
3. use appropriate software to simulate material and energy balances for process plants; and
4. use appropriate software to simulate and solve process models.

Course Contents

Use of computational tools to solve models and implicit equations covering transfer, separation, chemical reactions and thermodynamic systems involving steady and unsteady state. Process simulation using the HYSYS software or any other process simulation software, including ASPEN, MATLAB, Geogebra, Winplot, ESES.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;

3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment. Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations.

Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law **(2 Units C: LH 30)**

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

TCH 501: Plant Design II **(4 Units C: LH 15; PH 135)**

Learning Outcomes
At the end of this course, the students should be able to:
1. analyse existing process and carry-out process retrofitting;
2. perform flowsheet of the operating principles of reacting, pumping & piping, plant control, and utilities systems and execute the design of the systems;
3. analyse product/process design options and produce flow diagrams to obtain most suitable option;
4. perform process design of some units;
5. plan, produce and implement process calculations using software;
6. prepare and present findings of engineering design tasks;
7. perform process economics and determine process profitability, carry-out safety and environmental studies; and
8. present final design orally and in writing.

Course Contents
A design problem involving the study of a process. It should consist of preparation of flow sheet and heat and mass balances of the process and a detailed design of plant or unit operation equipment used in the process. Due consideration must be given to economics

and safety. Each student is expected to submit and orally defend a bound copy of technological/engineering design project. A design project should consist of introduction, literature review, process design, detailed design of some of the units of the process, specification of the equipment required, specification of materials of construction, basic mechanical design and drawings, inclusion of process control, modern drawings of the process equipment including a good flow chart, economic and environmental considerations.

TCH 555: Chemical Engineering Research Project (4 Units C: PH 180)

Learning Outcomes
Students will be able to:
1. identify the problem or hypothesis to research or tests;
2. identify resources and constraints;
3. identify the best option (Research method, process);
4. carry out research;
5. present data and conclusions according to the nature of research;
6. evaluate techniques and outcomes and suggest improvements; and
7. present the final report (orally and in writing).

Course Contents
Individual research projects under the supervision of an academic staff. Projects should focus on national and state industrial problems.

Minimum Academic Standards

Equipment
Pilot Plants
1. Continuous distillation pilot plant –
2. Liquid-liquid extraction pilot plant
3. Reaction pilot plant -
4. Multi-stage evaporation unit

Laboratory Scale Teaching Units
1. Shell and tube heat exchanger
2. Heat conduction and radiation apparatus – heat transfer
3. Unit operation lab: rotary, tray, fluidized bed and pneumatic dryers
4. Drying ovens and furnace, incubators, fridges, freezers
5. Chemical Reactors – CSTR, plug flow, batch reactors
6. Refrigeration experimentation units
7. Multifunction Process Control Teaching System
8. Cooling tower for humidification and heat transfer studies
9. Absorption column
10. Flooding and loading bench apparatus
11. Vapour-liquid equilibrium measurement apparatus
12. Adsorption columns
13. Rheometer for rheological investigation of non-Newtonian fluids in fluid mechanics
14. Sieve shakers and a set of sieve plates

General Apparatus
Assorted glasswares, balances, water baths,

Utilities

Boiler, compressor and vacuum pump

Analytical Equipment
Gas chromatograph, HPLC (High Performance Liquid Chromatograph), bomb calorimeter, spectrophotometer, centrifuges.

Computer Laboratories with Enough Computers dedicated to the Program and Available to Students

Staffing

Academic Staff
The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

Each course should be supported by at least 2 prescribed textbooks and 3 recommended textbooks which must be available in the library.

Below is a list of some useful textbooks. These are some of the textbooks commonly found in Chemical Engineering Library.

Most of these books and a whole lot more are available in electronic library. Most of the popular and international journals are available in the electronic library. Institutions are advised to subscribe to at least 3 databases that host these textbooks and journals.

List of Textbooks

1. Unit operations by McCabe & Smith
2. Introduction to Chemical Engineering by Badger & Banchero Unit Processes by Groggins
3. Chemical Technology by Dryden
4. Chemical Process Industries by Foust et al.
5. Chemical Engineering Thermodynamics by Dodge
6. Introduction to Chemical Engineering by Thompson & Ceckler
7. Mass Trasfer Operations by Treyball
8. Chemical Reactions Engineering by Levenspiel
9. Perry's Chemical Engineer's Handbook11
10. Coulson and Richardson (Vol.-1 to Vol.-6)
11. Transport Processes and unit operations by Christie Geankoplis
12. Introduction to Chemical Engineering Thermodynamics by J.M. Smith
13. Heat transfer principles by B.K. Dutta
14. Basic Principles and Calculations in Chemical Engineering by David M Himmelblau
15. Introduction to Material and Energy Balances by G.V. Reklaitis
16. Bioprocess Engineering by Michael L Shuler and Fikret Kargi

Academic and Non-Academic Spaces

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

S/N	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves.

B.Eng. Civil Engineering

Overview
Civil engineers plan, design and supervise construction of many essential facilities and structures such as bridges, dams, roads, buildings, ports, etc. Included in the study of civil engineering are courses in water resources and environmental engineering that are directly related to the solution of hazardous waste and pollution problems, providing potable and economical water supply systems, and maintaining a safe environment.

Philosophy
The Bachelor of Enginering and Technology B.Eng/B.Tech degree programme in Civil Engineering is based on the philosophy that the rate at which a nation progresses technologically is determined to a great extent by the size, quality, motivation and orientation of its science and engineering workforce. The programme should, thus, seek to train civil engineers who can best contribute to national development. For this, they must be equipped with the tools to understand, analyse, design and construct and maintain all possible physical facilities that can possibly promote appropriate development by conceiving and adapting techniques, processes and materials as necessary.
In consequence of the above, the programme is structured in such a way that students will have opportunity to take courses that will provide a basic understanding of all areas of civil engineering practice.

Objectives
The objectives of the Civil Engineering programme is to train civil engineers who are equipped with a broad-based experience ranging from engineering analysis and design to laboratory testing and experimentation in all areas of Civil Engineering with further concentration in the later years on, at least, several of the specialities. They would be equipped with:
1. a good grounding in basic engineering courses;
2. a good grasp of the essential application and utility courses;
3. a thorough understanding of the experimental and practical bases for the relevant theoretical engineering principles;
4. a good knowledge of all the various branches of civil engineering with further specialisation;
5. construction engineering and management skills (combining engineering and management skills to complete construction projects designed by other engineers and architects);
6. geotechnical engineering skills (analysis of soils and rock in support of engineering projects/applications - building foundations, earthen structures, underground facilities, dams, tunnels, roads.);
7. structural engineering skills (design of all types of stationary structures - buildings, bridges, dams);
8. surveying skills (measure/map the earth's surface in support of engineering design and construction projects and for legal purposes - locating property lines.);
9. transportation engineering skills (design of all types of transportation facilities/systems – streets/highways, airports, railroads, other mass transit, harbours/ports);
10. water resource skills (control and use of water, focusing on flood control, irrigation, raw water supply, and hydroelectric power applications);

11. environmental engineering (air pollution control, hazardous waste treatment and disposal, recycling and solid waste disposal, sanitary engineering (municipal and industrial water and wastewater treatment);
12. substantial practical skills for tackling real life engineering problems; and
13. knowledge of entrepreneurial and management principles upon which enterprising professional careers can be built.

Employability Skills

1. ability to apply scientific and engineering principles to plan, design and supervise civil engineering projects;
2. skills to convey technical material persuasively to clients, colleagues and subordinates;
3. knowledge of contemporary issues and ability to keep up with emerging technologies relevant to executing civil engineering projects; and
4. capacity to utilise the skills acquired in government (including regulatory and executing agencies), industry (including consulting, construction organisations) and academia.

21st Century Skills

The 21st century skills includes the innovative skills:

1. creativity and innovation;
2. critical thinking/problem solving/decision making;
3. communication;
4. collaboration (team work);
5. learning to learn/metacognition;
6. citizenship 9local and global);
7. general computer literacy and mastery of relevant information technology;

Unique Features of the Programme

1. sound exposure to all areas of civil engineering, including environmental engineering;
2. good exposure to allied areas such as law, economics and management;
3. Familiarity with general knowledge, including philosophy, entrepreneurial skills and history;
4. ability to communicate ideas effectively using modern tools involving computers, internet and telecommunication; and
5. capacity of graduates to establish their own businesses and go into paid employment with government or in industry; or pursue further studies.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters.
3. HND holders who enter the degree programme at 300 level should register for a minimum of 90 units of courses and a maximum of 120 units of courses.
4. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
5. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
6. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Discipline/ GET	Programme (CEE)	SIWES*	Total Units
100L	4	13	3	2	-	22
200L	4	-	26	2	3	32
300L	4	-	18	12	4	34
400L	-	-	-	3	8	3

500L	-	-	5	9	-	14
Total	**12**	**13**	**52**	**28**	**(15)**	**105**

*Not included in Total 105 units of 70% NUC CCMAS Component

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
CEE101	Introduction to Civil Engineering	2	C	15	
Total		**22**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45

CEE 201	Civil Engineering Drawing	2	E	15	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		**30**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ENT 312	Venture Creation	2	C	15	30
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	c		
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
CEE 301	Fluid Mechanics	3	C	30	45
CEE 303	Engineering Geology	2	E	15	45
CEE 304	Civil Engineering materials	3	E	30	45
CEE 307	Structural Mechanics I	2	E	30	-
CEE 308	Engineering Surveying and Photogrammetry I	2	C	15	45
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		**27**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 406	Engineering Surveying and Photo-grammetry II	3	E	30	45
*GET 499	SIWES III	8	C	24 Weeks	
Total		**0**			

***SIWES Courses**

GET 299	SIWES I	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24 weeks
Total Siwes Units		**15**		

*All credited in second semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
CEE 506	Construction Engineering	3	E	30	45
CEE 599	Project	6	C	-	270
Total		**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional). grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and

8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;

6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CEE 101: Introduction to Civil Engineering (1 Unit C: LH 15)

Learning Outcomes

Upon the successful completion of this course, students should be able to:

1. explain the profession of civil engineering and
2. the roles played by civil engineers.

Course Contents

History of civil engineering. Branches of civil engineering. Roles of civil engineers in government, industry and academia. Allied professionals and their interaction with civil engineers. Career oppoturnities in civil engineering, professional and regulatory bodies.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Learning Outcomes

Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five

principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and

8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Student Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal

spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;

9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-v-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;

3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

CEE 201: Civil Engineering Drawing (2 Units E: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. capable of drawing and detailing (by hand and using computer-aided-design skills) civil engineering structures; and
2. identify building structures, highways, pipelines, bridges, dams, foundations and so on using appropriate symbols and conventions.

Course Contents

Drawing and detailing (by hand and using computer-aided-design skills) of civil engineering structures,for example building structures, highways, pipelines, bridges, dams, foundations, etc. utilizing standard symbols and conventions, dimensions, notes, titles, etc. Relationship to specifications.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

6. analyse the concepts of peace, conflict and security;
7. list major forms, types and root causes of conflict and violence;
8. differentiate between conflict and terrorism;
9. enumerate security and peace building strategies; and
10. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

10. describe the key steps in venture creation;
11. spot opportunities in problems and in high potential sectors, regardless of geographical location;
12. state how original products, ideas and concepts are developed;
13. develop a business concept for further incubation or pitching for funding;
14. identify key sources of entrepreneurial finance;
15. implement the requirements for establishing and managing micro and small enterprises;
16. conduct entrepreneurial marketing and e-commerce;
17. apply a wide variety of emerging technological solutions to entrepreneurship; and
18. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
2. develop simple algorithms and use computational proficiency;
3. write simple proofs for theorems and their applications;; and
4. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation.

Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;

2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

CEE 301: Fluid Mechanics **(3 Units C: LH 30; PH45)**

Learning Outcomes
Upon completion of the course, students should be able to:
1. distinguish laminar from transitional and turbulent flows using the concept of Reynolds Number;
2. utilise boundary layer theory to estimate Lift and Drag;
3. derive the distribution of velocity and shear stress in laminar and turbulent flows respectively past flat plates and in circular conduits, and utilisation to obtain total flow, head loss, etc;
4. undertake similitude, development of physical hydraulic models, and scaling of the results from model to prototype;
5. analyse ideal fluid flow into sources from sinks, past circular and ellipsoidal bodies concerning doublets and flow nets;
6. analyse flow in pipes in series, parallel and any network, which may include pumps; and
7. obtain simplified estimates of forces exerted by flow in pipes due to rapid closing or opening of valves, and the use of surge tanks to reduce these forces.

Course Contents
Introduction to incompressible viscous flow, laminar and turbulent flows, Reynolds number; boundary layer flow, lift and drag. Laminar flow – in pipes, between parallel plates. Turbulent flows – along a plate, in ducts and pipes. Physical hydraulic models. Interconnected pipes and pipe network analysis. Potential flows and application to flow nets. steady and unsteady flow in closed conduits; water hammer, surge tanks.

CEE 302: Strength of Structural Materials (2 Units C:L H 30)

Learning Outcomes
Upon completion of the course, students should be able to:
1. utilise bending theory to obtain stress distribution across a bending section, as well as the slope and deflection at a section given any bending moment and shear force distribution along the beam;
2. determine whether a point in a material subjected to multidimensional stress will fail according to any failure theory;
3. explain the concepts of creep, fatigue and their implications in the use of structural materials;
4. analyse motion and stresses in springs;
5. determine the stresses and strains due to internal pressure on thin and thick cylinder walls; and
6. determine the stresses and strains induced in rotating disks and the implications.

Course Contents
Advanced topics on axial, lateral, and torsional loading of shafts and beams; slope and deflection of beams; unsymmetrical bending and shear centre; applications. Springs. Creep, fatigue, fracture and stress concentration. Stresses in thin and thick cylinders, and rotating disks. Multi-dimensional stress systems, Mohr's circle and failure theories.

CEE 303: Engineering Geology (2 Units E: LH 15; PH 45)

Learning Outcomes
Upon completion of the course, students should be able to:
1. describe the engineering properties of rock and soil materials;
2. identify the geological factors affecting the performance and functioning of a facility on and in the soil and/or rock;
3. conduct engineering geological investigations; and
4. explain the importance of engineering geology-related technical issues during construction.

Course Content
Geology structures and mapping; rocks and minerals; stratigraphy - time scale - fossils and their importance with special reference to Nigeria. Introduction to the geology of Nigeria; engineering applications - water supply, site investigations for dams, dykes and so on.

CEE 304: Civil Engineering Materials (3 Units E: LH 30; PH 45)

Learning Outcomes
Upon completion of the course, students should be able to:
1. explain the suitability of the use of the following as civil engineering materials: concrete, structural steel (and other important structural metals), timber, masonry;
2. conduct tests of engineering properties on civil engineering materials and utilise these for quality control;
3. explain the limitations of these materials under various uses; and
4. characterise variability and uncertainty associated with these materials.

Course Contents
Concrete Technology - types of cements, aggregates and their properties; concrete mix design, properties and their determination. Steel technology – production, fabrication and

properties, corrosion and its prevention. Tests on steel and quality control. Timber technology - types of wood, properties, defects, stress grading, preservation and fire protection, timber products. Rubber, plastics, asphalt, tar, glass, lime, bricks and applications to buildings, roads and bridges.

CEE 305: Soil Mechanics I **(3 Units C: LH 30; PH 45)**

Learning Outcomes
Upon the completion of the course, students should be capable of:
1. measuring soil properties in the laboratory;
2. interpreting and summarising the data;
3. classifying soils;
4. determining the optimum conditions for the compaction of soils and the ultimate amount achievable; and
5. estimating the settlement of soils due to compaction and consolidation.

Course Contents
Mineralogy of soils and soil structures. Formation of soils, soil classification, engineering properties of soils. Soil in water relationships - void ratio, porosity, specific gravity, permeability and other factors. Atterberg limits, particle size distribution, Shear strength of soils and Mohr's stress circle. Compaction and soil stabilisation, settlement, theory of consolidation. Laboratory work.

CEE 306: Design of Structures I **(2 Units C: LH 30)**

Learning Outcomes
Upon completion of the course, students should be capable of:
1. applying fundamental mechanics to the design of reinforced concrete structural elements using elastic design and limit state principles.

Course Contents
Fundamentals of design process, materials selection, building regulations and codes of practice; design philosophy. Elastic design, limit state design, of structural elements in reinforced concrete.

CEE 307: Structural Mechanics I **(2 Units E: LH 45)**

Learning Outcomes
Upon completion of the course, students should be able to:
1. explain the concept of statical determinacy of structures;
2. estimate the forces and deflections in statically determinate trusses;
3. estimate the shear forces, bending moments, slopes and deflection in statically determinate beams and portal frames; and
4. derive the influence lines for moving loads on trusses and beams.

Course Contents
Analysis of determinate structures - beams, trusses; structural analysis theorems, graphical methods; application to simple determinate trusses. Influence lines. Williot-Mohr diagram. Deflection of statically determinate structures - unit load, moment-area methods, strain energy methods. Introduction to statically indeterminate structures.

CEE 308: Engineering Surveying and Photogrammetry I (2 Units C: LH15; PH45)

Learning Outcomes

Upon completion of the course, students should be able to:

1. survey sites using chain surveying and compass;
2. obtain the levels at any location on a site and produce a contour map of the area;
3. conduct a traverse to establish the boundaries of a site; and
4. explain the principles of geodetic levelling and photogrammetry.

Course Contents

Chain surveying. Compass surveying methods. Contours and their uses. Traversing - methods and applications. Levelling - geodetic levelling - errors and their adjustments; applications. Tachometry- methods, substance heighting, self-adjusting and electromagnetic methods. Introduction to photogrammetry.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

CEE 406: Engineering Surveying and Photogrammetry II
(3 Units E: LH 30; PH 45)

Learning Outcomes
Students, upon completion of this course, should be able to:
1. use photogrammetry for surveying;
2. use topographical survey in preparation of contour maps;
3. use contour maps;
4. compute areas and volumes of earthwork; and
5. set out engineering works.

Course Contents
Further work on contours and contouring - methods of contouring, contour interpolation and uses of contour plants and maps, areas and volumes. Setting out of engineering works. Elementary topographical surveying. Elements of Photogrammetry, photogrammetric equipment and errors of measurements.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling,

motivation and appraisal of results.

GET 502: Engineering Law **(2 Units C: LH 30)**

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

CEE 506: Construction Engineering **(3 Units C: LH 30; PH 45)**

Learning Outcomes
At the end of this course, students should be able to:
1. plan construction activities incorporating the most appropriate combination of equipment and manpower;
2. manage construction to achieve quality construction at minimum cost and in least time; and
3. procure appropriate finance and insurance for construction projects at the least cost for the expected benefit.

Course Contents
Construction practices and professional relations. Earth-works. Construction equipment and techniques. Form-work design, component assembly. Improvement of productivity and construction practices. Safety. Capital outlay and operating cost, project financing, insurance and bonding, contract terms. Solutions to job site and engineering problems in buildings and heavy construction in Nigeria.

CEE 599: Project **(6 Units C: PH 270)**

Learning Outcomes
Upon completion of this course, students should be able to:
1. initiate worthwhile projects of a research or professional nature;
2. analyse the project problem and develop creative proposals for the solution;

3. execute the proposal for the solution to the problem; and
4. clearly and persuasively communicate solutions orally and in writing

Course Contents
For proper guidance of the students, projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their option subjects.

Minimum Academic Standards

Equipment
List of Laboratories/Workshop and Equipment

Structural Engineering
1. Civil Engineering Materials Laboratory
2. Structures Laboratory:
   Routine testing
   Models and prototype testing
   Studio/design office

Geotechnical Engineering
Field soil survey and testing (including sub-soil investigation and drilling)
Laboratory soil/rock testing

Geodetic Engineering and Photogrammetry
1. Laboratory equipment stores
2. Photogrammetry and Remote sensing Laboratory

Water Resources and Environmental Engineering
1. Hydraulics Laboratory
2. Hydrology Laboratory
3. (iii)Environmental Health Laboratory

Highway and Transportation Engineering
1. Highway Materials Testing Laboratory
2. Pavement Laboratory.

Major Equipment

Structural Engineering Laboratory
1. Universal Testing Machine with accessories for tension, compression,
2. transverse 180° cold bend, double shear, punching and brunel hardness tests. Capacity – 10000KN; Transverse beam – 500KN.
3. Proto-type tests facilities for testing of proto-type in structural elements, i.e. beams, frames, trusses, etc. Accessories for the purpose include 1000KN, 250KN load rings, electronic load cells, faculty workshop facilities, DEMEC High accuracy gauges, hydraulic jacks, etc.

4. Compression testing machine and transverse flexural testing frame: suitable for standard compression, flexural tensile tests and split cylinder tests on standard concrete and wood specimens to BS 1881 and CP 112 respectively. Shear rig can be manufactured and attached to this machine for testing shear strength of wood and glued wood joints. Capacity of the machine is 2500KN.
5. Routine testing and demonstration equipment: This includes armfield extensometres, arch frames, suspension bridge frame and pin-jointed frame work.
6. Concrete batching and making equipment:
   Multi-flow mixers, 112 Dm^3 (4ft^3) and 56 Dm^3(2ft^3) capacities 200-240V.
   Test BS sieves of various sizes
   Semi-automatic scale 25kg capacity
   Automatic scale 500kg capacity
   Standard moulds of various sizes and tamping rods
   Vibrating table
7. Concrete quality and workability equipment:
   Slump cone apparatus to BS 1881 ASTM CI43
   Compacting factor apparatus to BS 1881 (2 sizes)
   Vibro Consistometre to BS 1881
   Vicat apparatus
   Air entrainment metre

Water Resources and Environmental Engineering Laboratory
1. Laminar/turbulent pipe flow apparatus
2. Radial flow pump
3. Radial flow turbine
4. Surges in pipes apparatus
5. Surge tower
6. Water hammer apparatus
   a. Evaporating dish
7. Steam bath or infrared lamp
8. Drying oven
9. Desiccator
10. Analytical balance
11. Reagents – Sodium hydroxide, in distilled
12. Water, phosphate buffer solution, magnesium
13. Sulphate solution, calcium chloride solution, ferric chloride solution, acid and alkali solution, etc
14. Laboratory flow channel
15. Fibre glass
16. Thermometres
17. Funnels
18. Test Tubes

Geotechnical Engineering/Highway and Transportation Engineering Laboratory:
1. Tri-axial testing machine complete with transducers cells and accessories
2. Motorized direct/residual shear box machine complete with load rings, set of weights and accessories
3. CBR Testing machine complete with moulds, load ring gauges and accessories
4. Consolidation apparatus complete with cells, gauges and set of weights
5. Laboratory vane test apparatus complete with set of springs and motorizing attachment
6. Large capacity floor-mounting electric ovens 40^{o}C to 16^{o}C
7. Hotplates with Simmersat heat control unit 220–240V, 2000 W

8. Mettler top-loading balance with optical scale 100 g, Readability 0.01 g, capacity1.3 kg
9. Graduated twine beam scale complete with two stainless steel pans 0 to 200 g x10g
10. Semi-automatic balances, 25kg capacity complete with scoope and set of counter weights
11. Autographic unconfined compression apparatus complete with platens springs
12. Unconfined compression apparatus complete with platens and strain gauge mounting assembly and dial gauge
13. Automatic sieve shaker for up to 200 mm diametre sieve
14. BS sieves 212 mm to 8 mm and 200mm diametres
15. Simple hand boring sampling augers complete with accessories
16. Portable drilling unit with two-stroke petrol engine and two pairs of handles complete with extension rods
17. Atterberg limits determination apparatus complete with liquid limit device and accessories
18. High-speed stirrer complete with cup and baffler
19. Constant temperature bath complete with hydrometre jars, watt heater, thermostat, etc
20. CBR Marshall tester complete with breaking head stability mould and flow metre dial gauge
21. Compaction pedestal complete with hammer and mould body
22. Constant head permeability apparatus complete with cells and accessories
23. Standard proctor compaction mould, 1000 cm^3 capacity complete with rammers and accessories
24. GEONOR swelling test apparatus complete with cells and accessories
25. Riffle boxes complete with three rigid metal containers
26. Wax melting pot with thermostatic control up to 150°C range
27. Hand-operated extruder – screw type sample extruder for 38mm dia. Complete with built-in sample tube supports
28. Proctor/core cutter extruder comprising a frame and a 15-KN hydraulic jack
29. Universal extruder comprising a frame and a 15-KN hydraulic jack
30. Bench-moulding mixer with three-speed gear box complete with stainless steel bowl 7.5 dm^3 capacity
31. Long stem soil hydrometre graduated 0.995 to 1.030 g/ml
32. Sieving extractor complete with clamps and clamming ring for use with sieves of 200mm dia
33. Minor centrifuge complete with 8-place angle head, 8 x 50 ml metal buckets and caps
34. Ductilometre for testing 4 specimens complete with briquette moulds and base plate
35. Flash and fire-points apparatus gas heated.

Geodetic Engineering and Photogrammetry Laboratory:
1. Theodolites
2. Levels
3. Compasses
4. Umbrellas
5. Protractors
6. Steel tapes
7. Engineer’s chains
8. Ranging rods
9. Surveyor’s scales
10. Theodolites
11. Levels
12. Compasses
13. Umbrellas

14. Protractors
15. Steel tapes
16. Engineer's chains
17. Ranging rods
18. Surveyor's scales
    a. Various graph paper
    b. French curves
    c. Log tables
19. Planimetres
20. Plumbulbs
21. Arrows
22. Field books
23. Modern survey equipment as affordable e.g. Total Station, Global Positioning System (GPS), Terrestrial Laser Scanner (TLS).

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personne

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers**.**

Library Facilities
The following facilities should be provided to enable users make maximum use of library services:

1. Reading Rooms
2. Visually Impaired Resource Centre
3. Radio Frequency Identification (RFID) Security gate for theft detection
4. RFID tags for book tagging
5. Notebook computers for loan service
6. Over two hundred computers distributed at the various service points for Database search at the University library and Faculty Libraries
7. Workstations at the Faculty Libraries for Database search
8. Projectors and Screens for presentations
9. Photocopying machines
10. Scanners
11. Visually Impaired Resource Centre
12. Information display screen
13. E-Library (postgraduate and undergraduate sections)
14. Discussion Rooms

Types of Laboratories
Chemistry and Reaction laboratory
Unit Operations laboratories – at least 3
Instrumentation laboratory
Thermodynamics and Heat transfer laboratory

Physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves.

B.Eng. Computer Engineering

Overview

The Computer Engineering programme is designed to prepare the computer engineering graduate to acquire the requisite skills in the learning, literacy and life domains. The learning domain highlights critical thinking, creativity, collaboration and communication while literacy focuses on information, media, and technology complemented by the life skills that demonstrate flexibility, leadership, initiative, productivity and social balance. The Computer Engineering programme is conceived to produce engineers who can work with all aspects of computers (software and hardware) and other engineering professionals in a world in which high-level language software, complex programmes and smart hardware are complementing and progressively replacing human effort in solving societal problems.

The programme, therefore, prepares the students towards the design, analysis, and application of computers and computer-based systems in the development and production of peripheral and remote devices/computer systems to manage all economic sectors including services, energy, infrastructure, health, environment, entertainment, sports and security. Furthermore, the programme is designed to prepare the learner for the increasing need for Human-Computer Interface (HCI) requiring higher levels of automation and control of all aspects of the cyber physical environment engendered by the expanding age of Internet of Things and People (IoTP).

The Computer Engineering Programme includes several courses in Computation, Computer Science (such as data structures and operating systems) and Electrical and Electronics Engineering (such as circuits and electronics). Graduates are expected to have a sound knowledge of the fundamentals in electrical or computer engineering that allows them to analyse and solve technical problems, apply hardware and software tools to problem solving, and create, develop and manage complex computer-based technologies, products and services. The primary areas of specialisation are:

1. Artificial Intelligence (developing computers that simulate human learning and reasoning abilities)
2. Computer Architecture (designing new computer instruction sets, and combining electronic or optical components to yield powerful computing systems)
3. Computer Design and Engineering (designing new computer circuits, microchips, and other electronic computer components and devices)
4. Computer Theory (investigating the fundamental theories of how computers solve problems, and applying the results to other areas of computer engineering)
5. Information Technology (developing and managing information systems that support high-volume/speed data acquisition, processing, storage and retrieval for businesses and other organisations)
6. Operating Systems and Networks (developing the basic software used by computers to supervise themselves or to communicate with other computers, devices, humans and the environment)
7. Robotics (designing computer-controlled machines or robots for performing high-precision and high-speed repetitive industrial tasks and processes)
8. Software Applications (developing software to solve problems in multiple areas such as education, finance, space, medicine, infrastructure, etc.) and
9. Software Engineering (developing computer algorithms for solving complex problems of computation and analysis using different data forms).

New

This B.Eng./B.Sc./B.Tech. Computer Engineering Core Curriculum and Minimum Academic Standards (CCMAS) are approved by the National Universities Commission (NUC) for use in all Nigerian universities for the education and training of Computer Engineers. It is the product of the collaborative work of subject matter experts (SMEs) in the Nigerian universities and industry professionals/practitioners and regulators. It constitutes the latest revision to the National Universities Commission's (NUC's) B.Eng./B.Sc./B.Tech. Computer Engineering Benchmark Minimum Academic Standards (BMAS) which debuted in 2007. This new CCMAS contains many similarities with, as well as improvements over, equivalent programmes globally while also making allowance for individual Universities to create specialisation niches derived from environmental (local, international, industrial) need-based product differentiation.

Philosophy

The general philosophy of the Computer Engineering CCMAS is to produce graduates with hard, soft and research skills that are useful in analysing, evaluating, designing, developing, manufacturing, procuring, marketing, managing and maintaining the computing, electronics, communication, information processing, and operating systems embedded in computer hardware and devices used by individuals, and private and public organisations.

Objectives

The broad objective is to produce graduates that have the requisite knowledge, skills and emotional disposition needed for a 21st century world that increasingly demands greater, more advanced, efficient, sustainable and client-centric technological solutions. Specific objectives include:

1. applying the knowledge gained from courses in mathematics, science (social and basic), computing, and algorithmic reasoning to resolve Computer Engineering challenges individually or within multidisciplinary groups/teams;
2. understanding and applying discrete mathematics and computation;
3. defining complex engineering problems, collecting, analysing data and problems as well as developing models and implementing solutions for engineering problems;
2. analysing, designing and optimally managing the hardware/software computer system requirements of organisations with constrained resources;
3. using modern computer engineering models, tools, and information technologies to develop computer hardware;
4. undertaking research, and laboratory and real-life and real-time experiments by using computers and computer-based devices/systems and having the ability to acquire, analyse, and interpret data and to solve engineering and other problems locally and globally;
5. working on interdisciplinary and multidisciplinary concepts with teams as well as individually in developing new computer engineering knowledge, products, and services needed for the seamless functioning and wellbeing of society;
6. appreciating and using life-long learning to improve self-employability as well as adapting to future professional and ethical responsibilities in an efficient, effective, fair, responsible and competitive manner;
7. practising in different roles as engineering managers, project managers, innovators, entrepreneurs, quality controllers, researchers/knowledge creators and managers in the computer engineering field; and
8. having an understanding of contemporary as well as legal and ethical issues impinging on computer engineering solutions deployed in society.

Unique Features of the Programme

There are a number of unique features that characterise this computer engineering CCMAS curriculum:

1. a conscious duality focus in terms of preparing the students to ethically advance scientific knowledge as academics/researchers/trainers, and as culturally, environmentally sensitive and competent industry professionals;
2. more student directed learning, and reduction in classroom contact time by reducing each semester credits to between 15 – 18;
3. increased application of the computer system and computer software in the programme in both teaching and learning;
4. early familiarization of the students with the computer engineering discipline in terms of knowledge, skills and role expectations/responsibilities via an introductory course as early as the second semester of the first year of the programme;
5. 'signature Courses' (SCs): an allowance of 30% of total credits required for graduation to be used by individual Universities to introduce 'signature' courses/programmes pursuant to developing in-demand/industry-relevant knowledge/skills /technologies that target specific industry groups so as to drive innovation and entrepreneurship, research (R&D) funding by associated industry groups, minimise educational tourism/brain drain; deliberately create knowledge/skill/product/service differentiation among computer engineering programmes in Nigerian Universities thereby leading to deeper specialisation, wider and global recognition, emergence of Centers of Excellence and Influence (CEIs) and increased economic growth and development;
6. recommendation, and in some instances, outright prescription of cooperative or co-teaching for a course by resource persons from other disciplines/faculties in order to maximise learning;
7. recommendation of the use of more real-life/real-time simulation/demonstration approaches and qualified/certified industry-based facilitators for the delivery of courses in order to deepen learning, approximate industry contexts as well as engender more town and gown (R&D) and funding collaboration; and
8. capacity for increased skills in innovation, creativity and productive entrepreneurship orientation through the introduction of a capstone engineering business development and management course in the final year of the programme.

Employability Skills

Based on this CCMAS, the Computer Engineering programme graduate will acquire requisite skills that will enable them to:

1. apply knowledge of mathematics, science and computer engineering to the solution of local and global engineering problems;
2. identify, formulate, research literature and analyse computer engineering problems and proffer informed, efficient and effective theoretical and practical solutions;
3. design, develop and deploy computer-based systems, devices or processes to meet specified computer engineering needs;
4. apply critical reasoning and logic in resolving engineering problems using research-based knowledge and research methods including the set-up of experiments, analysis and interpretation of data, and distilling of information to create new knowledge, products and services;
5. create, select and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modelling and optimisation to developmental and complex engineering activities, with a clear understanding of the theoretical and practical limitations;
6. apply ethical principles at all times in practice as a subject matter expert and professional;

7. function effectively as an individual and as a reliable collaborator, partner, team member or leader;
8. communicate effectively on developmental or complex engineering activities;
9. demonstrate knowledge of the principles of organisation, engineering, management, corporate social responsibility and finance; and
10. exhibit evidence of independent and lifelong learning and community service.

21st Century Skills

The B.Eng./B.Tech./B.Sc. Computer Engineering CCMAS has the capability of inculcating into the graduate engineer skills essential for the 4th industrial revolution such as:

1. critical thinking and problem solving
2. creativity and innovation
3. collaboration and team work
4. communication and information literacy
5. media literacy
6. computation and data management
7. technology literacy
8. flexibility
9. leadership and ethical responsibility
10. initiative

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The degree title to be awarded under this CCMAS shall be a Bachelor of Engineering (B.Eng) or Bachelor of Science (B.Sc.) or Bachelor of Technology (B.Tech.) in Computer Engineering, as may be approved by the awarding University's Senate.

Candidates must have registered and passed all the compulsory courses specified for the programme.

Candidates admitted through the UTME mode shall have registered for, at least, 150 units of courses during the 5-year (cumulative residency) degree programme
The Computer Engineering programme shall be run according to the modularised course unit philosophy of this NUC CCMAS. All courses should, therefore, be sub-divided into more or less stand-alone but logically consistent and progressive learning packages that are taught within a semester and examined at the end of the particular semester with the appropriate composite practical/field/project work, as may be the case. Credits are weights attached to a course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures/tutorials or three hours of laboratory/studio/workshop work per week per semester of 15 weeks.
The determination of the class of degree shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme. The CGPA shall be used in the determination of the class of degree

Global Course Structure

Level	**General Studies**	**Basic Science**	**Discipline GET**	**Programme (CPE)**	**SIWES***	**Total Units**
100	4	10	3	2	-	19
200	4	-	22	-	3	26
300	2	-	14	10	4	26
400	-	-	-	11	8	11
500	-	-	11	12	-	23
Total	**10**	**10**	**50**	**35**	**15***	**105**

*All credited in the 2nd Semester of 400 level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
MTH 101	Elementary Mathematics I: Algebra and Trigonometry	2	C	30	-
MTH 102	Elementary Mathematics II: Calculus	2	C	30	-
PHY 101	General Physics I: Mechanics	2	C	30	-
PHY 102	General Physics II: Behaviour of Matter	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CPE 112	Introduction to Computer Engineering	2	C	30	-
Total		**19**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 203	Engineering Graphics and Solid Modeling II	2	C	15	45
GET 204	Students Workshop Practice	2	C	15	45
GET 207	Applied Mechanics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
GET 210	Engineering Mathematics II	3	C	45	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		**26**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
CPE 301	Computer Organisation and Architecture	2	C	30	-
CPE 302	Measurement and Instrumentation	3	E	30	45
EEE 321	Analogue Electronic Circuits	2	E	15	45
EEE 322	Digital Electronic Circuits	2	E	30	
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		**21**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
CPE 401	Microprocessor and Embedded	3	C	30	45

	Systems				
CPE 403	Control System	2	C	30	-
CPE 405	Fundamentals of Software Engineering	2	C	30	-
CPE 411	Hardware Design Techniques and Verification	2	E	30	-
CPE 413	Research Methods	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
Total		**7**			

***SIWES Courses**

Course Code	**Course Title**	**Units**	**Status**	**LH/PH**
GET 299	SIWES I: SWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24 weeks
Total		**15**		

*All credited in second semester of 400 level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
CPE 501	Testing, Reliability and Maintainability	2	C	30	-
CPE 502	Digital Signal Processing	3	C	45	-
CPE 505	Digital System Design with VHDL	2	E	30	-
CPE 511	Machine Learning and Applications	3	C	45	-
CPE 514	Professional Practice and Ethics	2	E	30	-
GET 599	Final Year Project	6	C	-	270
Total		**19**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;

4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using Le-Chatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, *n* th roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
4. identify the derivative as limit of rate of change;
5. identify techniques of differentiation and perform extreme curve sketching;
6. identify integration as an inverse of differentiation;
7. identify methods of integration and definite integrals;
8. solve some applications of definite integrals in areas and volumes; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II **(2 Units C: LH 30)**

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;

5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH15; PH45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and

development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CPE 112: Introduction to Computer Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of the course the student should be able to:

1. explain the profession of computer engineering;
2. the roles played by computer engineers; and
3. explain the historical development of computers.

Course Contents

Historical development of modern computing and computer engineering profession; roles and responsibilities of the computer engineer; career paths and development (public and private sectors, academic/research and industry); overview of computer engineering design; computer devices/hardware in the age of‛ smartness' and Internet of Things and People 'IoTs and P'; identification of computer software and hardware components and operational relationships (central processing units, input/output devices, operating systems, languages,

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.; introduction to basic design and operation of digital computers (information representation.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

CET 202: Basic Electronics (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the study, the student should be able to:

1. understand the basics of semi-conductors devices and their applications in different areas;
2. understand different biasing techniques to operate transistor, FET, MOSFET and operational amplifier in different modes;
3. analyse output in different operating modes of different semi-conductor devices; and
4. compare design issues, advantages, disadvantages and limitations of basic

Course Contents

Free electron motion in static electric and magnetic fields; electronic structure of matter, conductivity in crystalline solids, theory of energy bands in conductors, insulators

GET 201: Applied Electricity I **(3 Units C: LH 45)**

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, acceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electron quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

The material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers: definition of polymers as engineering materials; chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hand and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements.

Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and *n* th order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major.

The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;

5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills (steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports.

Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
4. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
5. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy

Practical Contents
Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basic part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

CPE 301: Computer Organisation and Architecture (3 Units C: LH 45)

Learning Outcomes
Upon completion of this course, the students will be able to:
1. describe the fundamental organisation of a computer system;
2. explain the functional units of a processor;
3. explain addressing modes, instruction formats and programme control statements;
4. identify the organisation of various parts of a system memory hierarchy;
5. describe basic concept of parallel computing; and
6. describe fundamentals concepts of pipeline and vector processing.

Course Contents
Computer fundamentals: development history of computer hardware and software; hard-wired vs stored program concept; Von-Neuman architecture; Harvard architecture: principle of operation, advantages and disadvantages; single address machine; contemporary computers; computer system: block diagram, functions, examples, dataflow and control line; computer arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic, arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits and demerits; storage and input/output systems: computer function (fetch and execute cycles), interrupts, interconnection structures (bus structure and bus types); overview of memory system, memory chip organisation and error correction, cache memory, and memory storage devices; overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor; control unit: micro-operations, control of the CPU, hard-wired implementation, control unit operation, micro-instruction sequencing and execution, and micro-programmed control; using INTEL family, and MOTOROLA family as case study of a CISC computer system; instruction set and register: machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organisation, and instruction pipelining; high performance computer systems: techniques to achieve high performance, pipelining, storage hierarchy, and units with function dedicated for I/O; RISC, introduction to superscalar processor, and parallel processor; using popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating system: overview of operating system, dimension and type of operating system: overview of operating system, dimension and type of operating system, high level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory,

UNIX/LINUX operating system: architecture, commands, programming; window-based operating systems (MS windows).

CPE 302: Measurement and Instrumentation (3 Units E: LH 30; PH 45)

Learning Outcome

At the end of the course the student should be able to:

1. analyse the performance characteristics of each instrument;
2. analyse basic metres such as voltmeters and ammeters;
3. explain different types of signal analysers;
4. explain the basic features of oscilloscope and different types of oscilloscopes; and
5. apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.

Course Contents

Transducers and applications; general instrumentation, basic meters in DC measurement, basic meters in AC measurements, rectifier, voltmeter, electro-dynamometer, and wattmeter, instrument transformers, DC and AC bridges and their applications general form of AC bridge, universal impedance bridge, electronic instruments for the measurement of voltage current resistance and other circuit parameters, electronic voltmeters, AC voltmeters using rectifiers, electronic multi meter, digital voltmeters; oscilloscope, vertical deflection system horizontal deflection system, probes, sampling CRO; and electronic function. generators.

CPE 307: Assembly Language Programming (2 Units C: LH 45)

Learning Outcomes

Upon successful completion of this course, the student will be able to:
(Knowledge Based)

1. understand basic assembly language syntax;
2. identify and use different 8086 addressing modes;
3. create and use a stack to store data, addresses, or both; and
4. highlight and know the uses of the different 8086 instruction groups.

(Skills)

1. development of general programming skills; and
2. be able to run assembly language code.

Course Contents

Introduction: Language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor; Intel 8086 microprocessor assembly language programming: programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, programme control, machine control, and input/output, etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions; modular programming; interrupt and service routine; interfacing of assembly language to C; Intel 80x87 floating point programming; introduction to MMX and SSE programming; Motorola 680x0 assembly language programming; extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

EEE 321: Analogue Electronic Circuits (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of the study, the student should be able to:

1. understand the basics of semiconductor devices and their applications in different areas;
2. understand different biasing techniques to operate transistor, FET, MOSFET and operational amplifier in different modes; and
3. analyse output in different operating modes of different semiconductor devices.

Course Contents

Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi storage amplifiers using BJTs and FETs.

EEE 322: Digital Electronic Circuits (2 Units E: LH 30)

Learning Outcomes:

Students will be able to:

1. classify, describe and discuss the various logic gates and flip-flops and multivibrators; and
2. design simple logic and sequential circuits using logic gates and flip-flops.

Course contents

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean algebra. Simplification of Logic expressions using Karnaugh Method. Design of combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counter. Registers and timers. Switching and wave shaping circuits. Generation of non-sinusoidal signal (multivibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc). Sequential circuits. Introduction to microprocessors.

400 Level

CPE 401: Microprocessor and Embedded Systems (3 Units C: LH 45)

Learning Outcomes

Upon the successful completion of the course, students will be able to:

1. develop an ALP in 8085 microprocessor using the internal organisation for the given specification;
2. describe the architecture and functional block of 8051 microcontroller;
3. develop an embedded C and ALP in 8051 microcontroller using the internal functional blocks for the given specification;
4. explain various peripheral devices such as 8255, 8279, 8251, 8253,8259 and 8237; and
5. explain microcontroller application and basic architecture of PIC, ARM and ATMEGA processors.

Course Contents

A basic microprocessor system: the CPU, memory, I/O, and buses subsystems, basic operation of a microprocessor system: fetch and execute cycle, the architecture of some typical 8-bit, 16-bit microprocessors (INTEL, MOTOROLA) and their features; programming model in real mode: registers, memory, addressing modes; organisation of the interrupt system, interrupt vectors, and external interrupts, implementation of single and multiple interrupts in real mode; programming model in protected mode: registers, memory management and address translation, descriptor and page tables, system control instructions, multitasking and memory protection, addressing modes, and interrupt system; memory interfacing and address decoding; I/O interfacing: memory mapped i/o, isolated i/o, bus timing, i/o instructions; peripheral devices interfacing: 8255 PPI/6821 PIA, 8251 USART/6821 UART, DMA, Timer/Counter chips, etc; instruction set; assembly language Programming of INTEL and MOTOROLA microprocessors; and discussion of a typical system e.g. IBM PC, Apple Macintosh.

CPE 403: Control Systems **(2 Units C: LH 30)**

Learning Outcomes
At the end of the course, students will be able to:
1. state examples of simple control systems;
2. state and explain different stability criteria and compensation methods for linear control systems; and
3. discuss non-linear control systems and their characteristics.

Course Contents
Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwitz criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nichol's chart, compensation techniques; introduction to non-linear systems.

CPE 405: Fundamentals of Software Engineering **(2 Units C: LH 30)**

Learning Outcomes
Upon successful completion of this course, the student should be able to:
1. identify, formulate, and solve software engineering problems, including the specification, design, implementation, and testing of software systems that meet specification, performance, maintenance and quality requirements;
2. elicit, analyse and specify software requirements through a productive working relationship with various stakeholders of a software development project;
3. function effectively as a team member;
4. understand professional, ethical and social responsibility of a software engineer;
5. participate in design, development, deployment and maintenance of a medium scale software development project;
6. convey technical material through oral presentation to, and interaction with, an audience;
7. convey technical material through written reports which satisfy accepted standards for writing style;
8. use Unified Modeling Language in software specification documents; and
9. evaluate the impact of potential solutions to software engineering problems in a global society, using the knowledge of contemporary issues and merging software engineering trends, models, tools, and techniques.

Course Contents
Introduction to software engineering fundamentals; object-oriented programming; number representations; data structure and algorithms, Abstraction, modules and objects; designing for efficiency; object-oriented software design and implementation.

CPE 411: Hardware Design Techniques and Verification (2 Units E: LH 30)

Learning Outcomes
Upon successful completion of this course, students will be able to demonstrate
1. adequate knowledge in digital electronics and digital design concepts;
2. ability to design and implement digital circuits under realistic constraints and conditions;
3. ability to debug, verify, simulate digital circuits;
4. ability to devise, select, and use modern techniques and tools needed for digital design; and
5. ability to work in a team.

Course Contents
Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes; micro-processors, system architecture, bus control, instruction execution and addressing modes; machine codes, assembly language and high-level language programming, micro-processors as state machines; microprocessor interfacing: input/output; technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters; system development tools: simulators, EPROM programming, assemblers and loaders, overview of available microprocessor application.

CPE 413: Research Methods (2 Units E: LH 30)

Learning Outcomes
Upon successful completion of this course, students will be able to:
1. Describe and explain key research concepts, issues, types of research and the systematic process of research gap identification and documentation and use contexts;
2. Search for, assembling and critically analysing research articles, papers and reports and general literature;
3. Formulate and evaluate research objectives, questions and hypotheses;
4. Developing a research proposal or industry project plan;
5. Identify and develop appropriate data acquisition and analysis methods and instrument;
6. Design/structure and lead the research process using appropriate research designs;
7. Use appropriate tools/techniques, including computer soft- and hardware /technologies to interpret, discuss and report/present the result and conclusions derived from research data analysis in oral or written form; and
8. Prepare/format/package research results/output for academic, journal articles, technical and other reports and exhibitions/fairs (scientific, trade, etc.) as an individual or team/work group.

Course Contents
Origins and definitions of research; problem identification and formulation; research types/design; qualitative, quantitative and mixed methods of research; measurement; sampling; data analysis; interpretation of data and technical report writing; use of encyclopedia, research guides, handbooks, academic databases for computing and computer engineering discipline; use of tools/techniques for research production: referencing

formats/styles and software; research management and reporting best practices; plagiarism-definitions, types, detection software; basics of document analysis, systematic review and management methods; practical documentation/presentation projects/seminars.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

CPE 501: Testing, Reliability and Maintainability **(2 Units C: LH 30)**

Learning Outcome

Upon successful completion of this course, the student will be able to:

(Knowledg-Based)

1. apply engineering techniques to prevent or reduce frequency of failures;
2. identify and correct the causes of the failures on engineering systems;
3. apply engineering techniques to estimate the reliability of new designs and analyse reliability data; and

(Skills)

1. predict expected life of the specific component, product or system; and establish risk analysis and quality control on engineering systems.

Course Contents

Introduction to reliability, maintainability, availability, elementary reliability theory; application to power systems and electronic components; test characteristics of electrical and electronic components; types of fault; designing for higher reliability; packaging, mounting, ventilation; protection from humidity, dust.

CPE 502: Digital Signal Processing **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students will be able to:

1. understand analytical tools such as fourier transforms, discrete fourier transforms, fast Fourier transforms and Z-transforms required for digital signal processing;
2. get familiarized with various structures of IIR and FIR systems;
3. design and realise various digital filters for digital signal processing; and
4. understand the applications of DSP in speech processing and spectrum analysis.

Course Contents

Discrete signals and Z-transform, digital fourier transform, fast fourier transform; the approximation problem in network theory; synthesis of low-pass filters; spectral transforms and their application in synthesis of high-pass and band-pass filters; digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; computer techniques in filter synthesis, realisation of filters in hardware and software; and basic image processing concepts.

CPE 505: Digital System Design with VHDL **(2 Units E: LH 30)**

Learning Outcomes

On completion of this course, the students will be able to:

1. explain VHDL as a programming language;
2. design the combinational and sequential logic circuits using VHDL;
3. design programmable logic devices (PLDs) and networks of arithmetic operations;
4. gain proficiency with VHDL software package and utilise software package to solve problems on a wide range of digital logic circuits.

Course Contents

Finite state machine: definition, mealy and Moore models, state diagram, state table, transition table; sequential circuits design using flip-flops, asynchronous and synchronous circuit design; algorithm state machine; design examples and exercises; structured design: design constructs, design levels, geometry-based interchange formats, computer-aided electronic system design tools, schematic circuit capture, hardware description languages, design process (simulation, synthesis), structural design decomposition; introduction to VHDL: VHDL language abstractions, design hierarchies, VHDL component, lexical description, VHDL source file, data types, data objects, language statements, concurrent VHDL, sequential VHDL, advanced features of VHDL (library, package and sub-programmes); structural level modelling, register-transfer level modelling, FSM with data path level modelling, algorithmic level modelling; introduction of ASIC, types of ASIC, ASIC design process, standard cell ASIC synthesis, FPGA design paradigm, FPGA synthesis, FPGA/CPLD architectures; VHDL Design: top-down design flow, verification, simulation alternatives, simulation speed, formal verification, recommendations for verification, writing RTL VHDL code for synthesis, top-down design with FPGA; VHDL synthesis, optimisation and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives; and computer-aided design of logic circuits.

CPE 511: Machine Learning and Applications (3 Units C: LH 45)

Learning Outcomes

On the successful completion of this unit, students should be able to:

1. identify the characteristics of datasets and compare the trivial data and big data for various applications;
2. select and implement machine learning techniques and computing environment that are suitable for the applications under consideration;
3. solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues;
4. understand and apply scaling up machine learning techniques and associated computing techniques and technologies;
5. recognise and implement various ways of selecting suitable model parametres for different machine learning techniques; and
6. integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and mapreduce.

Course Contents

Introduction to machine learning; ; introduction to R or Python for machine learning: statistics for analytics: descriptive statistics, inferential statistics, estimation and hypothesis testing, ANOVA; machine learning: unsupervised learning – clustering, supervised learning – classification, decision trees, random forest, and model performance measures.

CPE 514: Professional Practice and Ethics (2 Units E: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. have a holistic picture of professional practice in computer engineering;
2. be abreast of the ethical and professional issues and landmines inimical to their practice and how to navigate them;

3. be totally ready (professionally, technically, legally and emotionally) for any professional entrepreneurial, financial and managerial challenges they may encounter; and
4. be abreast of the standards, codes and intellectual property implications of and values associated with, professional practice.

Course Contents

Engineering profession: structure and specializations (Nigeria and abroad), engineering basics, development of engineering profession, ethics and computer engineering, strands in ethical thinking, organisations and their structures: limited liability companies, private and public, partnerships, sole traders, special features of limited companies, responsibilities of directors; company finance: the need for capital; investment and working capital; sources of funds; equity capital and loan capital, cash flow and its importance, costing: fixed costs and variable costs; overheads; opportunity costs; depreciation; problems of cost allocation; budgeting; assessment of capital investment; discounted cash flow analysis, with particular reference to investment in software tolls and new product development; financial accounts: balance sheets, profit and loss accounts, cash flow statements; the treatment of software in company accounts; ownership of rights in software as goodwill; anatomy of software house: the company, company structure, management of staff, producing of budget, monitoring financial performance, producing budgets, computer contracts and intellectual property rights: the nature and types of intellectual property; intellectual property law (confidentiality, copyright, trademarks, and patents) and implications for the computing, computer engineering and software industry; computer misuse and criminal law: computing and criminal activity, reform and criminal law, categories of misuse, computer fraud, unauthorized access ;data protection: data protection and privacy, the impact of the internet; sociology of data management/processing: generation, users, regulation/control and general management; Professional and industry codes of conduct(local and international).

CET 599: Final Year Project (6 Units C: LH 270 PH)

Learning Outcomes

The student(s) will develop a technology and/or system to solve a known and significant computer engineering problem and design, and if possible/practicable, build/produce/ manufacture some relevant new hardware/device(s) representing the solution using the skills acquired in the computer engineering programme.

Course Contents

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the computer engineering degree.

Minimum Academic Standards

Equipment

Recommended List of Minimum Equipment

Basic Computer Laboratory		
S/N	Name of Equipment/Brief Specification	
1.	Computer System (with latest configurations)	
2.	Software	
3.	Microsoft Windows	
4.	Red Hart Linux	
5.	Oracle	
6.	Page Maker Professional (latest version)	
7.	Corel Draw (latest version)	
8.	Adobe Photoshop	
9.	Microsoft Office Suite (latest version)	
10.	Antivirus Software (licensed for at least 200 users)	
Programming Laboratory		
1.	Computer System (with latest configurations)	
2.	Turbo C and C++ Compilers (latest versions)	
3.	VB.Net (latest version)	
4.	Javas Compiler (latest version)	
5.	Python compiler (latest version)	
6.	R Compiler (latest version)	
7.	Antivirus Software (licensed for at least 50 users)	
Digital Electronics And Microprocessor Laboratory		
1.	Computer System (with latest specifications)	
2.	Online UPS (5 KVA) OR 625 VA UPS for each Computer System	
3.	Assembler for 8085 programming	
4.	Antivirus (10 user License)	
5.	8085-based Trainer Kits	
Add on Cards		
6.	Add on card to study interfacing of LED display control using 8255	
7.	Add on card to study interfacing of LCD with 8085-based microprocessor	
8.	Add on card to study speed control of stepper motor using 8085-based microprocessor including stepper motor	
9.	Familiarization of ICs trainer (7400),(7402), (7432), (7486), (7408), (7404), (7483), (7485), (74157), (74151), (74138	
10.	EX OR, and EX-NOR Gates realisation kit (using NAND OR NOR Gates)	
11.	Realisation of Truth Table for OR and NAND Gates using NAND Gates and NOR Gate	
12.	8 bit digital multiplexer	
13.	1:8 line de-multiplexer	
14.	Multiplex two BCD numbers to seven segment display	
15.	Study of Flip Flop or RS, D,J-K and T	
16.	3 bit asynchronous up-counter3 bit synchronous down counter	
17.	Universal shift registers having SISO, SIPO, PIPO, PISO	
18.	Study of D-latch and D flip flop trainer	
19.	Encoder/decoder trainer	

20.	Digital IC testers	
21.	Digital Laboratory with modules	
22.	Logic Probe	
23.	Logic Pulser	
24.	Pulse Generator upto (3MHz)	
25.	Digital Frequency Metre	
26.	Digital IC Programmer	
27.	Digital IC power supplies (+/- 5V/1A, +/-12V/1A/+-15V, 1A)	
28.	15 Macs	
29.	2 Calliope autonomous robots with camera and robotic arm	
30.	Apple iPads and Samsung tablets.	
31.	Digitised oscilloscopes with spectrum analysers	
32.	Digitised function generators	
33.	Digitised power supplies	
34.	Digital circuit design and microcontroller boards (EasyAVR and BigAVR microprocessor boards. Easy 8501 development boards).	
35.	Raspberry PIs.	
36.	Protoboards.	
Advanced Computer Laboratory		
1.	Multimedia computer systems with latest specifications	
2.	Online UPS (5 KVA)	
3.	Multimedia projector with accessories	
4.	24 Port Switch	
5.	Digital camera	
6.	Scanner	
7.	Laser printer	
8.	Touch screen	
9.	Laptop with latest configurations	
10.	Adobe Creative Suit (latest Version)	
11.	Visual Studio 6.0 or (latest Version)	
12.	Adobe Flash Professional	
13.	Adobe Flex (latest version)	
14.	Adobe Dreamweaver	
15.	Web camera	
16.	Antivirus (licensed for at least 50 users)	
Hardware Laboratory.		
1.	Trainer board to demonstrate assembling and working of multimedia computer system	
2.	Trainer boards to study mother boards with different chipsets and processors	
3.	Hard disk trainer board (SATA and IDE)	
4.	CDROM trainer board	
5.	Mouse trainer board	
6.	Keyboard trainer board	
7.	Trainer board to study construction and working of colour CRT monitor	
8.	Trainer board to study construction and working of colour LCD Monitor	
9.	Trainer board to study working of dot matrix printer, Inkjet printer	

	and colour laser printer	
10.	Trainer board to study switch mode power supply	
11.	Trainer board to study working of UPS	
12.	Trainer board to study construction and working of floppy disk drive	
13.	Computer repair and assembly tool kits	
14.	Computer system with latest specifications	
15.	Online UPS(3 KVA)	
16.	PC tools	
17.	Antivirus (5 users)	
18.	USB hard disk	
Data Communication and Networking Laboratory		
At least 2Mbps Internet facility should be available in Laboratories.		
1.	Computer system with latest specifications	
2.	19" rack	
3.	24 port switch	
4.	Windows 2003 server or latest version (10 user license)	
5.	Red hat linux (20 user license)	
6.	Data backup utility software	
7.	Data communication trainer board	
8.	LAN trainer system	
9.	Amplitude modulation/demodulation trainer board	
10.	Frequency modulation/demodulation trainer board	
11.	Pulse code modulation/emodulation trainer board	
12.	CRO 25 MHz (minimum)	
13.	Trainer board to study frequency division multiplexing/ demultiplexing	
14.	Trainer board to study time division multiplexing/ demultiplexing	
15.	Digital multimetre	
16.	Wireless access points	
17.	Wi-Fi LAN cards	
18.	Network/bandwidth management software (cybernetra or equivalent)	
19.	Trainer board to study the working of MODEM	
20.	LAN cable tester	
21.	Crimping tool	
22.	Display boards of various types of cables and connectors used in computer networks	
23.	Tool kits	
24.	Online UPS (5 KVA)	
25.	Network printer	
26.	Antivirus(10-user license)	
Operating System Laboratory		
1.	Computer system with latest specifications	
2.	Online UPS (7 KVA) OR 625 VA UPS for each PC	
3.	Server with latest specifications	
Software		
1.	Windows 98/XP/2000/Vista/Windows 7/Windows 10	
2.	Windows 10 server or latest version	
3.	Oracle academic version (latest version with at least 20- user license)	

4.	SQL server	
5.	Antivirus (with at least 20-user License)	
Central Computer Laboratory		
1.	Multimedia computer system with latest specifications	
2.	Online UPS (7 KVA)	
3.	24 port switch	
4.	Network printer	
5.	Scanner	
6.	Dot matrix printer	
7.	Antivirus (20 user license)	
8.	LCD projector	
Electronics/Signal Processing Laboratory		
1.	Digitised Oscillisopes with Spectrum Analysers	
2.	Digitised Function Generators	
3.	Digitised Power Supplies	
4.	Digital Circuit Design and Microcontroller Boards	
5.	Computers for Data Acquisition and Computer Aided Design (CAD	
6.	40 work stations	
7.	Software includes: AutoCAD	
8.	MatLab	
9.	Comsol	
10.	STAAD	
11.	Other engineering design software	

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers**.**

Library Facilities

The following facilities should be provided to enable users make maximum use of library services.

1. Reading Rooms
2. 24 Hour Reading Rooms
3. Visually Impaired Resource Centre
4. Radio Frequency Identification (RFID) Security gate for theft detection
5. RFID tags for book tagging
6. Notebook computers for loan service
7. Over two hundred computers distributed at the various service points for Database search at the University library and Faculty Libraries
8. Workstations at the Faculty Libraries for Database search
9. Projectors and Screens for presentations
10. Photocopying machines
11. Scanners
12. Visually Impaired Resource Centre
13. Information display screen
14. E-Library (postgraduate and undergraduate sections)
15. Discussion Rooms

Classrooms, Laboratories, Workshops, Clinics and Offices

Space Requirements

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50

Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Electrical Engineering

Overview
Electrical Engineering encompasses the application of engineering sciences to analyse the electrical energy conversions, transformations, supplies, utilisation and reliability principles to the study of electrical and related engineering aspects of human needs such that electrical energy management systems and qualities of system operations can easily be designed, constructed and function in both economical and safe environments. Aspects of Electrical engineering consist of electric power generation, transmission and distribution, utilisation and management of the entire aspects. The programme is designed to ensure that students acquire the requisite skills and knowledge that will allow them to demonstrate competence in the general field of Electrical Engineering, and, at the same time, allow students to be able to interact with the general public while carrying out their functions as engineers.

Philosophy
The general philosophy of the Electrical Engineering programme of the universities is to produce graduates with a high academic standard, adequate practical background and skills that are of immense value to the industry and the nation in general. The programme is intensive in nature in order to turn out engineers capable of solving local problems. In pursuance of the above, the following specific features have been incorporated into the programme:

1. common foundation years at 100 and 200 levels for all engineering students;
2. Workshop practice, technology, laboratory work and tutorials;
3. design projects with a bias towards local applications;
4. broad-based engineering and interaction between students and professionals;
5. project in the final year on which the student works alone under supervision;
6. special skills and in-depth study in a particular area of the programme through optional courses or electives;
7. adequate knowledge in the areas of Electrical Engineering Management, Economics and Law; and
8. entrepreneurial/Entrepreneurship studies to equip students for world of work.

Objectives
In line with the above philosophy, the objectives of the programme are to:
1. produce graduates with high academic standards coupled with practical experiences, sufficient to meet the challenges of developing economies and adequately tackle common everyday engineering problems;
2. encourage close contact between the students and their lecturers by means of seminars and workshops, design, office consultation, tutorials and laboratory work;
3. produce graduates with broad-based knowledge in general studies, management and humanities, all of which enhance their understanding, contribution and relevance to the immediate society;
4. provide an excellent balance between engineering principles and their relevant applications to the creative world of Engineering practice;
5. broaden the horizon of its students by incorporating managerial and social aspects of their subjects as well as Engineer-in-Society and Entrepreneurship studies into their programmes of learning;

6. conduct lectures complemented with visits to engineering industries, vacation trainings, Student Work Experience Programme as well as Industrial Trainings;
7. expose students to current trends in research methodology; and
8. equip our graduates with adequate knowledge for job creation as a means of contributing to national development.

Unique Features of the Programme

Unique features of the curriculum include:

1. digital literacy: the curriculum incorporates significant digital programmes for graduates to remain competitive within today's digital economy;
2. competency based outcome: it establishes the desired knowledge, skills, and behaviours of graduating students that enable them to successfully perform in professional, educational and other contexts;
3. focus on learning: it is devised to focus on learning to enhance the learning experience of the students by integrating diverse techniques and complementary technologies;
4. entrepreneurial skills: it provides entrepreneurial skills for knowledge based and digital economy; and
5. collaborative: it provides for collaboration with the industry in order to realise the much-needed practical knowledge and skills required to take on the present-day challenges.

Employability Skills

Graduates of the Electrical Engineering programme are actively sought by employers in both the private and public sectors. Potential employers include large and small businesses, government at all levels, national and multinational corporations, and universities. Self-employment as engineering consultants and other technically applied positions is an expanding career option for electrical engineering professionals.

Electrical engineering graduates will be equipped with the following employability skills:

1. communication skills: the ability to present ideas effectively with confidence through aural, oral and written modes, not only with engineers but also with the community at large;
2. creativity and innovation skills: the ability to create new ways of thinking and be able to find solutions to new problems by being innovative enough to build new products and services;
3. information literacy: the ability to access, evaluate, synthesis and share information from multi-disciplinary / interdisciplinary sources;
4. competence in application and practice: the ability to use techniques, skills, and modern engineering tools for solving engineering problems;
5. team work skills: the ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member;
6. problem solving and decision-making skills: the ability to solve engineering problems through critical thinking, system thinking and effective decision making;
7. engineering system approach: the ability to utilise systems approach to design and evaluate operational performance;
8. knowledge of contemporary issues: the ability to continue learning independently in the acquisition of new knowledge, skills and technologies. The use of information, communication and computing technologies are very essential in the knowledge-based era; and
9. understand professional, social and ethical responsibilities: the ability to understand the social, cultural, global and environmental responsibilities of a professional engineer, and commitment to professional and ethical responsibilities.

21st Century Skills

1. Professional and interpersonal skills with competence in the areas of professionalism and teamwork;
2. Business and management skills with competence in management, entrepreneurship and leadership;
3. Mental and thinking skills consisting of competences in critical thinking, decision making, creativity and innovation; and
4. Information and communication skills.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Faculty (GET)	Programme (TEL/EEE)	SIWES	Total Units
100	4	15	3	2	-	24
200	4	-	22	3	3	32
300	4	-	15	9	4	32
400	-	-	-	0	8	8
500	-	-	5	4	-	9
Total	**12**	**15**	**45**	**17**	**15**	**105**

100 Level

Course code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Introduction to Solid Modelling Design and Engineering	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	E	-	45
TEL 100	Introduction to Electrical Engineering	2	C	30	
	Total	**24**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-

GET 203	Solid Modelling and Design Engineering	2	C	15	45
GET 204	Students Workshop Practice	2	C	15	45
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 207	Applied Mechanics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
TEL 202	Applied Electricity II	3	E	45	-
EEE 208	Electrical Engineering Materials	3	C	45	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**29**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	
GET 306	Renewable Energy Systems and Technologiy	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	
EEE 321	Analogue Electronic Circuits	2	C	30	
TEL 303	Electric Circuit Theory	2	C	30	
TEL 304	Measurements and Instrumentations	2	C	30	
TEL 305	Electrical Machines	3	C	45	
TEL 324	Electromagnetic Theory	2	E	30	
TEL 322	Electrical Energy Systems	2	E	30	
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**28**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TEL 421	Control Engineering	2	E	30	
TEL 423	Power Electronics	2	E	30	
TEL 401	Advanced Renewable Energy Systems	2	E	30	
TEL 402	Software/Computer Applications in Electrical Engineering	2	E	15	60

*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

***SIWES Courses**

GET 299	SIWES I: SIWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

*All credited in second semester of 400 level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TEL 502	Electrical Services Design	2	C	30	-
TEL 507	Electric Power Systems Engineering	2	C	30	-
TEL 503	Energy Economy	2	E	30	-
	Total	**9**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making), etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;

8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

TEL 102: Introduction to Electrical Engineering (2 Units C: LH 30)

Learning Outcomes

On the completion of the course students will be able to:

1. predict the behaviour of any electrical and magnetic circuits;
2. formulate and solve complex AC, DC circuits;
3. identify the type of electrical machine used for that particular application;
4. realise the requirement of transformers in transmission and distribution of electric power and other applications; and
5. function on multi-disciplinary teams.

Course Contents

Electrical circuits (electrical quantities – Units, DC and AC Signals, Root-Mean-Square (RMS) Value, Average Value, Instantaneous Values, Form Factor, Crest Peak or Amplitude Factor); Electrostatics (Introduction, Capacitors, Capacitance, Capacitance of an Isolated Sphere, Spherical Capacitor, Parallel Plate Capacitor, Capacitors in Series and Capacitors in Parallel); magnetism and electromagnetism (Introduction, Absolute and Relative Permeabilities of a Medium, Magnetic Induction (Magnetic Flux Density), Flux Per Unit Pole, Field Intensity or Field Strength, the Production of Magnetic Induction by a Current, Biot-Savart Law (Laplace's Law), Magnetic Circuit, Comparison of the Electric and Magnetic Circuits Magnetisation Curves; Electromagnetic Induction; Faraday's Laws of Electromagnetic Induction); Basic laws and theorems (Introduction, Ohm's Law, Kirchhoff's Laws, Superposition Theorem, Thevenin Theorem, how to thevenize a given circuit, Delta/Star transformation and Star/Delta transformation); three phase system (Introduction, Relationship between line and phase voltage, Delta connected system with a balanced load, power with balanced 3-phase load, Measurement of Power in a 3-phase three-wire system and Power Factor Measurement); electric power (Introduction, Power in an Alternating Current Circuit, Active, Reactive and Apparent Power, Power Triangle, Power Factor, why improve Power factor, Power factor in a Capacitive Circuit, the Practical importance of Power Factor, Effect of low Power Factor, Power Factor Corrective Equipment, Effect of reactive power consumption, StaticVar Compensations for AC and DC Transmission and Industry, Typical Static Var Compensator, Advantages of Static Var Compensator, Power Factor Economics and Electricity Tariffs); introduction to electrical machines (Electric Machines and Transformers, Classification of Electrical Machines, Basic Equations of DC Machines, Operating mode of DC Machines, Transformers, Ideal Transformer and Efficiency of a Transformer); basic electronics (Introduction, Electronic Tubes, Semi-conductors, Junction Diode, Field Effect Transistor and Optoelectronics); electrical measurement (Measurement of Resistance by the Voltmetre-Ammetre Method, Ohmmetres and A. C. Bridges).

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 45)

Learning Outcomes
Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents
Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 203: Engineering Graphics and Solid Modeling II (3 Units C: LH 30; PH 45)

Learning Outcomes
Students should be able to:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;

7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 207: Applied Mechanics **(3 Units C: LH 45)**

Learning Outcomes
Students will acquire the ability to:
1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;

3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Content

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

TEL 202: Applied Electricity II (3 Units E: LH 45)

Learning Outcome

Upon the completion of the course, students will be able to:

1. use computational tools and packages in the design of electric power systems, electronic, and digital equipment and systems;
2. solve common, technical problems in the design of electronics and electrical circuits including electric power systems, and seek specialist advice as needed for more complicated problems;
3. identify the process of innovation and the main factors of entrepreneurship and creative thinking, and apply methods of product development;
4. apply project management methods to the planning of projects;
5. plan, manage and analyse projects, using current best-practice methods; and
6. carry out a cost estimate for a design solution, and understand the uncertainties associated with the cost estimation process.

Course Contents

Power factor, Power in AC circuit, Resonance in RLC series and parallel circuit, Three Phase Circuits: Voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams. DC Machines: Construction, Basic concepts of winding (Lap and wave); DC generator: Principle of operation, EMF equation, characteristics (open circuit, load) DC motors: Principle of operation, Torque Equation, Speed Torque Characteristics (shunt and series machine); Single Phase Transformer: Constructional parts, Types of transformers, Emf equation, No Load no load and on load operation, phasor diagram and equivalent circuit, losses of a transformer, regulation and efficiency calculation; Three Phase Induction Motor: Types, Construction, production of rotating field, principle of operation, Slip and Frequency, rotor emf and current, Equivalent circuit and phasor diagram, Torque Slip characteristics torque-speed characteristics; General Structure of Electrical Power System: Power generation to distribution through overhead lines and underground cables with single line diagram, Earthing of Electrical Equipment, Electrical Wiring Practice.

EEE 208: Electrical Engineering Materials (3 Units C: LH 45)

Learning Outcomes

On the successful completion of this module, students should be able to:

1. describe the internal structure of atoms and molecules;
2. describe the different types of crystals and the defects evident within them, and explain how these defects affect the mechanical and magnetic properties of materials;
3. discuss how the bonding within materials affects the properties of the material;
4. carry out the standard tests to determine the mechanical and magnetic properties of materials;
5. describe the electrical and thermal properties of materials; and
6. demonstrate transferable skills.

Course Contents

Atomic Structure and Bonding: the internal structure of the atom will be examined and will include the electron orbital model of atomic structure. This will be extended to explain the different types of bonding, which occurs within materials. Crystal Structure: The main types of crystal lattices will be examined and the defects, which may occur, will be described. Properties of Materials: The main properties of materials will be described as will the methods used to quantify them: Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids; Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode; Elementary discrete devices fabrication techniques and IC technology.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;

3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy and so on. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;

5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes
At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (3 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

EEE 321: Analogue Electronic Circuits (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. classify, describe and discuss the principles of operation and applications of FET and BJT; and
2. calculate amplifier parameters; and design simple amplifiers using BJT and FET with given specifications.

Course contents

Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers.

Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi-stage amplifiers using BJTs and FETs.

TEL 303: Electric Circuit Theory (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students will be able to:

1. identify linear systems and represent those systems in schematic form;
2. apply Kirchhoff's current and voltage laws and Ohm's law to circuit problems;
3. simplify circuits using series and parallel equivalents and using Thevenin and Norton equivalents;
4. perform node and loop analyses and set these up in standard matrix format;
5. identify and model first and second order electric systems involving capacitors and inductors;
6. predict the transient behaviour of first and second order circuits.
7. analyse important electronic circuits (Amplifiers, Active Filters, and Oscillators).
8. use simulation software (SPICE);
9. Build/ make measurements, test and troubleshoot electronic circuits; and
10. design important electronic circuits (amplifiers, active filters, and oscillators).

Course Contents

Basic Concepts:

Introduction, Systems of Units, Charge and Current, Voltage, Power and Energy, Circuit Elements.

Basic Laws: Ohm's Laws, Nodes, Branches, and Loops, Kirchhoff's Laws, Series Resistors and Voltage Division, Parallel Resistors and Current Division, Wye-Delta Transformations.

Methods of Analysis: Nodal Analysis, Nodal Analysis with Voltage Sources, Mesh Analysis, Mesh Analysis with Current Sources, Nodal and Mesh Analyses by Inspection, Nodal Versus Mesh Analysis.

Circuit Theorems: Linearity Property, Superposition, Source Transformation, Thevenin's Theorem, Norton's Theorem, Derivations of Thevenin's and Norton's Theorems, Maximum Power Transfer.

Operational Amplifiers: Operational Amplifiers, Ideal Op Amp, Inverting Amplifier, Noninverting Amplifier, Summing Amplifier, Difference Amplifier, Cascaded Op Amp Circuits, Op Amp Circuit Analysis.

Capacitors and Inductors: Series and Parallel Capacitors, Inductors, Series and Parallel Inductors.

First Order Circuits: The Source-free RC Circuit, The Source-free RL Circuit, Singularity Functions, Step Response of an RC Circuit, Step Response of an RL Circuit, First-order Op Amp Circuits.

Second Order Circuits: Finding Initial and Final Values, The Source-Free Series RLC Circuit, The Source-Free Parallel RLC Circuit, Step Response of a Series RLC Circuit, Step Response of a Parallel Circuit, General Second-Order Circuits, Second-Order Op Amp Circuits:

Sinusoidal steady-state analysis. AC circuit power analysis. Polyphase circuits. Magnetically coupled circuits; Complex frequency and Laplace transform; Circuit analysis and the s-Domain; Frequency response: Bode Diagram. Fourier circuit analysis.

TEL 304: Measurements and Instrumentation (2 Units C: LH 30)

Learning Outcomes

At the end of the course, the student should be able to:

1. analyse the performance characteristics of each instrument;

2. illustrate basic metres such as voltmetres and ammetres;
3. explain about different types of signal analyseanalysers;
4. explain the basic features of oscilloscope and different types of oscilloscopes; and
5. apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.

Course Contents

Introduction: Significance of Measurement and block diagram of Measurement System, Static characteristics- Accuracy, Precision, Sensitivity, Linearity, Repeatability, Reproducibility, Resolution, Threshold, Drift, Stability, Dead zone, hysteresis, Dynamic Characteristics- speed of response, measuring lag, fidelity, dynamic error, Types of Errors – Gross error, systematic errors, Random errors.

Measuring Instruments: PMMC, DC voltmetre and current metres and its Extension ranges, True RMS Responding Voltmeter, Average responding rectifier type voltmetre, electronic voltmetre, block diagram approach for measurement of voltage, current and Resistance using Digital Multi Metre (DMM), Basic Potentiometer Circuit, Q-meter – Series Method.

Bridges and AnalyseAnalysers: DC Bridge- Wheatstone bridge, Kelvin's Double Bridge, AC Bridge- Maxwell's Bridge, Schering bridge and Wien's Bridge. Signal Analysers: Frequency Selective and Heterodyne Wave Analysers, Harmonic distortion Analysers, Total Harmonic distortion, Spectrum AnalyseAnalysers.

Oscilloscopes: Cathode Ray Tube (CRT), Electrostatic Deflection, Post-deflection and Acceleration of Electron Beam, Screens for CRT's, Block diagram of CRO, Time-based Generator, Delay line, Attenuators, probes, Dual beam oscilloscope, Dual trace oscilloscope, Digital Storage Oscilloscope, Applications of CRO: Measurement of Phase and Frequency using Lissajous Patterns.

Transducers: Transducer and its classification, ideal features of Transducer – Resistive Transducer: Potentiometric type, Strain Gauge type (Gauge factor derivation, SG materials, Bonded and unbounded strain gauges), Capacitive Transducers - Variable gap type, variable area type and variable Dielectric type, Inductive Transducers - LVDT, Thermocouple, Thermistor, Piezo Electric Transducers, Piezoelectric effect, Piezoelectric materials, RTD, photo voltaic cell, LDR.

TEL 305: Electrical Machines (3 Units C: LH 45)

Learning Outcomes

At the end of the course the student should be able to:

1. explain operating principles of fundamental components of Electric Machines: motors, generators and transformers including synchronous, asynchronous, DC and special purpose motors, AC, DC generators and autotransformers, CTs, PTs, step-up and step-down transformers;
2. examine the magnetic field, reluctance of magnetic materials, flux and mmf in magnetic circuits and perform transformer analysis using standard testing procedures including open-circuit and short-circuit tests, voltage regulation, efficiency and circuit analysis involving transformers;
3. examine construction, working principles, characteristics and equivalent circuit of three phase synchronous generators, synchronous motors and induction motors, single phase induction and special purpose motors; and
4. analyse voltage-current characteristics, commutation of DC generators, torque speed characteristics and speed regulation of DC motors.

Course Contents

DC Machine, Introduction to Machinery Principles, Rotational motion, Newton's Law and power relationships, the Magnetic field, Magnetic Circuit with air gap, Faraday's law, Production of induced force on wire, Induced voltage on a conductor moving in a magnetic field, Linear DC machine.; DC Machinery Fundamentals: Simple rotating loop between curved pole faces, Commutation, Construction, Simple armature winding, Armature reaction, Interpoles, compensating winding and brush shifting, Internal generated voltage and induced torque equations of real machines; DC Generators, Introduction, Voltage regulation, Magnetization curve, Equivalent circuits, Working and characteristics of separately excited, shunt, series and compounded generators, Parallel operations of direct current generators; DC Motors, Introduction, Speed regulation, Equivalent Circuits, Working and Characteristics of separately excited, Shunt and Permanent magnet, Working and Characteristics of series and compounded motors, Torque–speed Equations, Efficiency calculations, Stepper Motor and Drive circuit.; AC Machines Topics, Transformer Fundamentals, Importance of transformers, Types and construction, The ideal transformer, Leakage reactance, Theory and operation of single phase transformer, Losses and phasor diagram, the equivalent circuit of a real transformer, No load and short circuit test, the per unit system, the transformer voltage regulation and efficiency, Autotransformers and concept of its power rating advantages, Current transformer (CT) and Potential transformer (PT), Three phase Transformers, Construction of power Transformer, Three phase connections and harmonics suppression, Vector groups, Three phase transformer using two transformers, Transformer ratings and related problems, Transformer Inrush Current, AC Machines Fundamentals, A simple loop in a uniform magnetic field, Review of three phase generation, Proof of the rotating magnetic field concept and its relation with no. of poles, the relationship between electrical and mechanical degree, the relationship between electrical frequency and the speed of the magnetic field rotation Induced voltage and induced torque, Losses and power flow diagram, Voltage regulation and speed regulation.; Synchronous Generator, Construction, Excitation system, Equivalent circuit of Synchronous Generator, Phasor diagram, Power and Torque, Measurement of model parametres, Effect of load changes on a generator, Parallel operation of generators; Synchronous Motor, Basic principle of motor operation, Equivalent circuit, Torque speed characteristics, Power and torque equation, Phasor diagram, the effects of load change, and field current change, V-curves of synchronous motor and power factor correction, Starting of synchronous motor, Synchronous motor ratings; Three Phase Induction Motor, Construction, Basic concepts and working principles, Synchronous speed, Slip and its effect on rotor frequency and rotor voltage, Equivalent circuit, Power and torque, Torque speed characteristics, losses, efficiency and power factor; Single Phase and Special Purpose Motors, The Universal motor, Introduction to single phase induction motor, Starting single phase induction motors, Split phase windings, Capacitor start motor, Permanent split capacitor motor, Capacitor start and capacitor run motors, Shaded pole motors, Reluctance motors, the Hysteresis motor.

TEL 322: Electrical Energy Systems (2 Units E: LH 30)

Learning Outcomes

At the end of the course, the student should be able to:

1. recognise the structure and operation of electricity generation, transmission and distribution systems and the impact on the society and environment;
2. solve problems involving modeling, design and performance evaluation of power transmission lines;
3. analyse power flow in power transmission networks and apply power flow results to solve simple planning problems;
4. calculate currents and voltages in a faulted power system under both symmetrical and asymmetrical faults, and relate fault currents to circuit breaker ratings; and

5. analyse the transient stability of simple power systems using equal area criterion.

Course Contents

Generation of electric energy: Sources of energy. Heat value of fuels. Thermal stations. Hydroelectric stations. Nuclear stations.

Economics of power supply: Fixed and running charges in electric power production. Load curves and load duration curves including concept of base, intermediate and peak load. Definition of load factor, maximum demand, Diversity factor and their effects on generation.

Distribution system: Survey of power system components: feeders, distributors, services mains, radial and ring-man systems. Voltage drop in distribution systems. Per-unit qualities.

Overhead transmission system: Conductors and insulators. Transmission line parameters. Resistance, inductance and capacitance. Skin effect. Corona discharge. Stringing: Calculation of sag and tension. Stringing chart and performance. Representation of short and long power lines. Underground cables: Types. Inductance of concentric cables. Capacitance of single-core and three-core cables. Thermal characteristics. Sheath currents.

Circuit breakers: Principles of arc-extinction. Types of circuit breakers. Current growth in a purely inductive circuit. Interpretation of circuit breakers lest oscillographs. Current chopping. Resistance and capacitance switching. Breaking and making currents.

TEL 324: Electromagnetic Theory (2 Units E: LH 30)

Learning Outcomes

At the end of the course, the student should be able to:

1. perform vector analyses used for electromagnetic waves;
2. define basics of electro and magnetostatics;
3. explain Maxwell equations and time-dependent Helmholtz equations;
4. define plain electromagnetic waves and wave equations;
5. understand the basic mathematical concepts related to electromagnetic vector fields;
6. apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density;
7. apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density;
8. understand the concepts related to Faraday's law, induced emf and Maxwell 's equations; and
9. apply Maxwell's equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

Course Contents

Electromagnetics – Motion and Vector algebra, Integral calculus, Curvilinear coordinates, Divergence and Stokes's theorem, Coulomb's law, Electric field; Electrostatics – Gauss's Law, Electric potential, Conductors, Dielectrics, Capacitance, Capacitors, Electrostatics Energy and Forces, Poisson's Equation, Method of Images, Boundary Value Problems, Current Density, Ohm's Law, Kirchhoff's and Joule's Laws; Magnetostatics – Vector Magnetic Potential, The Biot-Savart Law, the Magnetic Dipole, Magnetic Materials, Boundary Conditions, Inductors, Energy, Forces; Electrodynamics – Electromagnetic Induction, Maxwell's equations, Potential Functions, Boundary Conditions, Wave Equations;

Review of EM laws in integral form; Gauss law. Ampere's law and Faraday's laws; uniform em plane waves: Magnetic fields in and around current carrying conductors. Conduction and displacement currents; Derivation of Maxwell's equations in curl form from Faraday's and Ampere's laws; Time varying electric and magnetic fields in free space the wave equation; Plane waves in vacuum, dielectric conducting and lossy media; Skin effect; Polarisation of

waves; Poynting vector and energy propagation in free space; Boundary conditions; Plane waves in unbounded dielectric media. Reflection and transmission of plane waves.
Em radiating systems: Antennae - isotropic antenna, elementary dipole near the far fields. Antenna parametres. Half-wave antenna. Practical antenna e.g. loop, horn and parabolic

400 Level

TEL 401: Advanced Renewable Energy Systems (2 Units E: LH 30)

Learning Outcomes

At the end of the course the student should be able to:

1. make interpretation about the energy sources;
2. comprehend the energy and energy types; and adverse consequences of greenhouse gases;
3. understand the various energy sources in Nigeria;
4. make interpretation about the solar energy;
5. explain the solar energy power plants;
6. explain the solar energy collectors;
7. make interpretation about the wind energy;
8. explain the production of electricity from wind energy;
9. explain the production of energy method from hydrogen; and
10. design standalone and grid connected electric power from renewable sources

Course Contents

Energy and civilization, fossil fuels: availability and depletion, Nuclear Energy, Global Warming, Green and Renewable Energy Sources. Estimates of energy costs, components of electric grid, electric energy outlook in Nigeria. Distribution and generation technologies and economics. Fundamentals of Solar Power Systems Photovoltaic Power Conversion, Photovoltaic Material, Modelling of Photovoltaic Systems, Design of Photovoltaic Systems, Concentrated Solar Power. Fundamentals of wind power systems wind power conversion, modelling of wind power systems, design of wind systems. hydrogen energy, energy storage and other renewable energy sources. Integration of distribution and generation into the grid dc/ac inverters, analysis of dc/ ac inverter dc/dc converters, design of converters for grid operation. Impact of distribution and generation on power system operation, voltage variations circuit, overloading system protection, ride through and fault mitigation, power quality disturbances.

TEL402: Software/Computer Applications in Electrical Engineering (2 Units E: LH 15 PH 45)

Learning Outcome

On the completion of the course, the student should be able to:

1. analyse a control problem and suggest an appropriate system architecture;
2. analyse the need for information exchange and suggest appropriate information models and protocols;
3. develop simple software for a controller;
4. analyse the information needed for a given automation and control function for power systems;
5. create consistent information models for power systems control; and
6. use of matlab/simulink for analysing performances of power systems.

Course Contents

The course consists of three blocks, each consisting of a project assignment, lectures and exercise sessions:

Block One includes analysis and modeling of the need for Information exchange for power system control. The aim is to train the students to analyse different perspectives on information necessary for power system control. The project assignment in the block includes implementation of a simple information model for the exchange of data on power systems.

Block Two includes basics in programming techniques and computer science focusing on machine learning methods with applications in power systems. The project assignment in the block consists of developing machine learning algorithms for forecasting.

Block Three includes Introduction to matlab: Laboratory oriented course designed to introduce students who already have taken a programming course to programming in MATLAB. Topics include introduction to the MATLAB environment, matrix manipulation and computation, MATLAB programming language, writing functions and scripts, and production of 2D graphical output.

TEL 421: Control Engineering (2 Units E: LH 30)

Learning Outcome

At the end of the course the student should be able to:

1. have working knowledge of process control;
2. model engineering processes from first principles and use step response data;
3. design controllers for different process applications;
4. use the techniques, tools and skills related to process control, computer science and modern process control engineering in modern engineering practice; and
5. communicate system related concepts effectively.

Course Contents

Feedback concept, advantages, system classification, structures; Control system components - mechanical, electronic hydraulic, thermal, position control; Transient analysis of servo-mechanism, signal regulators compensation techniques; Series/parallel feedback controllers. System transfer functions, signal flow graphs, stability, Routh-Hurwitz criteria.

TEL 423: Power Electronics (2 Units E: LH 30)

Learning Outcomes

On the completion of this course, students should be able to:

1. understand the principles of power control by switching; demonstrate the benefits of switched mode circuits; be familiarised with the commonly used semi-conductor switching devices;
2. demonstrate a full understanding on several DC-DC converters; perform analysis on their operation principles; develop design equations for selecting their components;
3. be able to explain how the steady-state AC voltage and current are related to each other in power circuits using phasor analysis;
4. understand and be able to quantify active, reactive and apparent power;
5. comprehend the operation principles for several thyristors-based rectifiers; quantify the current harmonics and the average power drawn by a rectifier;
6. understand the H-bridge based inverters and their several control methods; develop the skills in analysing the different modes of operations for the inverters; gain the understanding on how the power is delivered or absorbed by grid-connected inverters.

Course Contents

The basics of three-phase circuits, connections, voltage and current analysis and real and reactive power calculations; the fundamentals of electricity conversion from the form supplied by the source to the forms required by the load; power electronic conversion techniques, including the basic converters (DC-DC, AC-DC and DC-AC) and their power switching and control methods; the methods of circuit analysis applicable to switched mode circuits; essential properties of the relevant semiconductor devices; simple converters for practical applications.

Topics: Characteristics of power devices; DC-DC converters; AC Current, Voltage and Power; Effects of power electronics on AC power Rectifiers (AC-DC converters) and Inverters (DC-AC converters).

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;

2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles to undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

TEL 502: Electrical Services Design (2 Units: C: LH 30)

Learning Outcomes

At the end of the course the student should be able to:

1. design a complete distribution network for different purposes;
2. apply safety precaution in the design of distribution network;
3. function on multi-disciplinary teams;
4. identify, formulate, and solve engineering problems;
5. communicate effectively; and
6. use the techniques, skills, and modem engineering tools necessary for engineering practice.

Course Contents

Basic Electrical Installations; Distribution system, regulations - IEE, NEC, Nigeria standards; Illumination, Cables - types, ratings, wirings system, earth protection; Auxilliary electrical systems - fire alarm, telephone, elevator circuits, proposals, contract document preparation; Design of electrical installations - domestic, industrial, commercial air conditioning.

TEL 507: Electric Power Systems Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of the course, the student should be able to:

1. apply the knowledge of mathematics, and engineering to the analysis of electrical machines and transmission lines;
2. design and conduct experiments, as well as analyse and interpret data;
3. identify, formulate, and solve engineering problems in the area of electromechanical energy conversion devices;
4. understand and apply some knowledge of contemporary issues concerning Electrical/Energy systems; and
5. use techniques, skills, and modem engineering tools necessary for engineering practice.

Course Contents

Basic single-phase modeling. Three phase system analysis. Three phase models of transmission lines. Three phase models of transformers. Formation of the system admittance matrix. Modeling of Static AC-DC Conversion Plant: Introduction. Rectification, inversion. Communication reactance. DC transmission. Load Flow: Introduction, Basic nodal-method. Conditioning of Y matrix. The case where one voltage is known. Analytical definition of the problem. Newton-Raphson method of solving load flow problem. Techniques that make Newton-Raphson Me Basic single-phase modeling. Three-phase system analysis. Three-phase models of transmission lines. Three-phase models of transformers. Formation of the system admittance matrix. Modeling of Static AC-DC Conversion Plant: Introduction. Rectification, inversion. Communication reactance. DC transmission. Load Flow: Introduction, Basic nodal-method. Conditioning of Y matrix. The case where one voltage is known. Analytical definition of the problem. Newton-Raphson method of solving load flow problem. Techniques that make Newton-Raphson Method competitive in load flow. Characteristics of the Newton-Raphson load flow method. Decoupled Newton load flow method. Fast Decoupled load flow. Convergence criteria and tests. Numerical examples. AC-DC Load Flow: Introduction. Formulation of the problem. DC system model. Solution techniques. Control of converter AC terminal voltage. Extension to multiple and or multi-terminal DC systems. DC convergence tolerance. Test system and results Numerical examples.Optimal operating strategies: Scheduling of generation, types generating stations and their tecno-economic operating characteristics Fault analysis and Control strategy: types of system protection, generators, transformers, lines etc protection schemes switchgear and circuit breakers operating principles and types.

TEL 503: Energy Economy **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course the student should be able to:

1. demonstrate knowledge of the Nigerian and the world energy situation;
2. understand the economic fundamentals of energy demand and supply;
3. understand the economic fundamentals underpinning energy types;
4. be familiar with the important theoretical work that underpins the study of energy economics; and
5. appreciate the important energy policy issues.

Course Contents

This course explores the theoretical and empirical perspectives on individual and industrial demand for energy, energy supply, energy markets, and public policies affecting energy markets. It discusses aspects of the oil, natural gas, electricity, and nuclear power sectors and examines energy tax, price regulation, deregulation, energy efficiency and policies for controlling emission.

Minimum Academic Standards

Equipment

S/N	Description of Equipment	Remarks
Basic Electrical Engineering Laboratory		
1	Tubular fluorescent lamp set	Or Equivalent
2	Energy metre	
3	Single phase induction motor	
4	Transformer	
5	Load box, single phase resistive	
6	Drilling machine	
Electrical Circuit Network and Device Laboratory		
1	Network theorem kit	Or Equivalent
2	Maximum power transfer thm. Kit	
3	Transient response kit	
4	Low pass filter kit	
5	High pass filters kit	
6	Thevenins theorem kit	
7	Superposition theorem kit	
8	Ramson's make dc power supply	
Electrical and Electronics Measurement Laboratory		
1	Owens bridge	Or Equivalent
2	Anderson bridge	
3	Desauty bridge	
4	Maxwell bridge	
5	Schering bridge	
6	B -H curve kit	

Electrical Machine Laboratory		
1	D.C. shunt motor and exciter	Or Equivalent
2	3φ Alternator	
3	3φ Synchronous motor	
4	3φ Squirrel cage induction motor	
5	3φ slip ring induction motor	
6	1φ Alternator	
7	D.C Generator (series, shunt, compound)	
8	3φ Sq. Cage induction motor	
9	D.C compound motor	
10	3φ Auto transformer	
11	1φ capacitor start capacitor run induction motor (Crompton greaves)	
12	1φ, split phase induction motor	
13	1φ repulsion motor	
14	1φ shaded pole induction motor	
15	Universal motor (ac/dc)	
Control and Instrumentation Laboratory		
1	Linear Variable Differential Transformer MODULE KIT	Or Equivalent
2	Temperature measurement trainer kit	
3	Strain measurement trainer kit	
4	Process control simulator	
5	temperature control system	
6	Synchros transmitter and receiver trainer kit	
Machine Design and Simulation Laboratory		
1	Computer set (Workstation)	Or Equivalent
Power Electronics / Electrical Drives Laboratory		
1	Chopper / inverter PWM Controller	Or Equivalent
2	3Ph. Converter firing unit	
3	SCR pulse controller with 3Ph. SCR module	
4	Intelligent power module	
5	Smart power module with chopper/ inverter PMW controller	
6	fully controlled converter power circuit	
7	3Ph. isolation transformer	
8	Series inverter kit	
9	Cosine law triggering of ac/dc converter	
10	3Ph. IGBT based PWM inverter	
11	Chopper inverter	
12	1Ph. capacitor start motor	
13	DC shunt motor	
14	3 Ph. induction motor with GEP sensor	
15	3Ph. slip ring induction motor	
16	1Ph. isolation transformer	
17	3Ph. diode bridge trainer kit	
18	TRIAC voltage control kit	
Power System Laboratory		
1	Idmtover current relay of earth fault testing kit	Or Equivalent
2	Microprocessor based over/under voltage relay with testing kit	
3	Percentage biased differential relay with testing kit	

4	High voltage oil testing kit	
5	Single phase transmission line kit	
High Voltage Laboratory		
1	Impulse generator with voltage divider	Or Equivalent
2	Lightning impulse setup (can be used for universal purposes)	
3	Cascaded transformers	
4	Digital partial discharge detectors	
5	Capacitance and loss angle measuring bridge	
6	Modules (capacitors, resistors, spark gaps, rectifiers, pressure vessels etc.)	
7	Dielectric frequency response analyser	
8	RTDS (Real Time Digital Simulator)	
9	Omicron CMC 356 and 256 with GPS synchronisation (universal testing solutions)	
10	Omicron Dirana (Insulation Diagnosis)	
11	Omicron CPC 100, with current boost up to 2000A	
12	Portable impulse generator	
13	Voltage and current probes, including Rogowski current probes	
14	Tektronix oscilloscopes 4054 B, 2014 and TBS 2000 Differential and distance relays that can be used to test different protection strategies.	
Microprocessor Laboratory		
1	8051 Based MC Trainer Kit	Or Equivalent
2	DC Motor Speed Measurement and Control	
3	EPROM Programmer	
4	Logic Controller Interface	
5	Thyristor SCR Trainer Pulse Generator	
6	89C51 CPU Card	
7	80196 CPU Card	
8	ADUC 812 CPU card	
9	C-Cross Compiler for 8051	
10	PC Keyboard and LCD Display Card	
11	Measurement Card	
12	Relay Card	
Renewable Energy Laboratory		
1	Alternative Renewable Energy Trainer (RENY0001)	Or Equivalent
2	Photovoltaic Solar Energy Unit Trainer (RENY0004)	
3	Fuel Cell Teaching Experiment Platform	
4	Portable Solar Power Experiment Box	
5	Power Battery Management System Test Bench	
6	Portable Solar Power Experiment Box	
7	Power Battery Management System Test Bench	
8	Solar PV modules with stand	
9	Solar Stand (Tilting)	
10	Channel Data logger system with the following Sensors: Anemometer Sensor; Silicon Type pyranometer sensor; Surface temperature sensor.	
Electrical Workshop		
1	Transformer Oil Testing Kit	Or Equivalent
2	3 Phase Induction Motor (Winding Study)	

3	Coil Winding Machine	
4	Megger Metre	
5	Hand Operated Crimping Tool	
6	Single Phase Induction Motor	
7	Cathode Ray Oscilloscope	
8	Cable Fault Locator	
9	Power Drilling Machine	
10	Wattmeters and Energymeters	
11	Galvanometers and Voltmeters	
12	Ammeters and Multimeters	
13	Function Generators	
14	Soldering iron	

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library that is well equipped with specialised books and journals in both physical collections and E-collections (E-Resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribed repository of:

1. Institutions (national and international)
2. Open access sources
3. Professional Bodies' e-learning platforms
4. Relevant international organisations

The library must also have adequate facilities for the following:

1. Reading
2. Provisions for lending
3. Reservation unit for specialised materials

Classrooms, Laboratories, Workshops, Clinics and Offices
The NUC recommends the following physical space requirement:

Academic	**m²**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Electronics Engineering

Overview
The B.Eng/B.Tech/B.Sc. in Electronics Engineering programme focuses on electronics as a specialty in the electrical engineering field. It provides students with up-to-date courses in microelectronics and applications. It covers analysis and design using latest international tools and software adopted by modern industry. This curriculum was designed to include a solid background of the primary electrical engineering areas such as computers, communications, power and control. Students acquire the needed practical skills that go hand-in-hand with the learned theoretical knowledge in various fields.

Philosophy
The Electronics Engineering programme aims at providing future engineers with appropriate theoretical knowledge and technical skills to respond to professional market demands. More specifically, the programme aims to produce graduates who understand systems constituents, behaviours and analysis in the following areas:
1. Electronic systems and circuits
2. Communication systems
3. Control systems
4. Electronics and communication of computer systems
5. Electromagnetic fields systems and applications

Objectives
The aim of the electronics engineering programme is to produce students with a strong foundation in engineering science and design that will enable them to pursue productive career in not only the electronics engineering field, but also to be used at he foundation for career in other areas such as business, management and medicine. Typical industries in which the electronics engineering graduate would be employed could include those in communication systems, telecommunication networks, analogue systems, hardware/software integration, digital and microprocessor system.

Programme Learning Outcomes
Upon the successful completion of the 5-year Electronics Engineering programme, the student should be capable to:
1. demonstrate knowledge and understanding of the fundamental electrical concepts;
2. analyse and understand the behaviour of any electronic circuit and equipment;
3. design electronic and electrical communication systems;
4. plan and implement applied research activities, evaluate outcomes, and draw reasonable conclusions;
5. demonstrate the need to maintain their technical skills and develop new ones through personal development and life-long learning;
6. convey technical information through their proficiency in written and spoken communication skills; and
7. demonstrate an understanding of professional and ethical responsibilities to their field and to society.

Unique Features of the Programme
Electronics Engineering is at the core of the modern world, from computers to digital circuits, photonics and a wealth of electronic devices. This new programme offers a unique combination of complementary knowledge and skills in Electronics and Artificial Intelligence,

New

allowing graduates to pursue a wide range of engineering interests and career choices. This programme produces graduates with knowledge to provide society with the complex electronic systems it needs as well as the software required to operate these systems.

Employability Skills

Along with having an affinity for solving problems and a strong interest in technology for a successful career in electronics engineering, the following essential skills are needed:

1. Strong IT skills along with efficiency in programming. An upcoming electronics engineer should have command of a number of high-level programming languages like C, C++, Python, computer-aided design tools, and circuit simulators to analyse designs;
2. Practical experience of different circuits and electrical systems. Technical thinking requires critical thinking skills to identify common issues and to come up with working solutions;
3. Communications skills;
4. Time management and an ability to prioritise and plan work effectively.

21st Century Skills

While it is true that certain basics of engineering will not change in the 21st century with the rise of artificial intelligence (AI) and robotics technology, there will be an increased premium for the following competencies:

1. Critical thinking ability (that is the ability to think analytically and holistically;
2. Life-long learning;
3. Holistic and multidisciplinary learning;
4. Intra/inter-personal skills (communication skills, teamwork, collaboration and global competence); and
5. Technical skills (modeling and simulation, competency in computer programming, statistical literacy and data science, machine learning and AI).

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:
1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**GST/ENT**	**Basic Sciences**	**Discipline (GET)**	**Departmental (ELE)**	**SIWES***	**Total Units**
100	04	13	03	02	-	22
200	04	-	20	-	03	27
300	04	-	11	07	04	26
400	-	-	00	04	08	14
500	-	-	05	11	-	16
Total	**12**	**13**	**44**	21	**15**	**105**

**All to be credited in the 2nd semester of 400-Level*

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**

GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People's and Culture	2	C	30	
CHM 101	General Chemistry I	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
PHY 101	General Physics I: *Mechanics*	2	C	30	-
PHY 102	General Physics II: *Behaviour of Matter*	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
MTH 101	Elementary Mathematics I: *Algebra and Trigonometry*	2	C	30	-
MTH 102	Elementary Mathematics II: *Calculus*	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
ELE 101	Introduction to Electronics Design and Practice	2	C	15	45
Total		**22**			

200 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	30	45
GET 202	Engineering Materials	3	C	45	-
GET 203	Engineering Graphics and Solid Modeling II	2	C	15	45
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		**24**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and	3	C	30	45

	Technologies				
GET 307	Introductionn to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
ELE 313	Analog Electronic circuits	3	C	30	45
ELE 318	Digital Electronics	2	E	30	-
ELE 324	Communication Principles	3	E	45	-
ELE 305	Circuit Theory	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		**22**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ELE 403	Engineering Mathematics IV	3	C	45	-
ELE 405	Engineering System Modeling and Simulation	3	C	45	-
ELE 407	Data Communications and Networking	3	E	45	45
ELE 411	Advanced Electronic Circuits Design	3	E	45	45
TEL 423	Power Electronics	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
Total		**6**			

***SIWES Courses**

Course Code	**Course Title**	**Units**	**Status**	**LH/PH**
GET 299	SIWES I: SIWEP	3	C	9 Weeks
GET 399	SIWES II	4	C	12 Weeks
GET 499	SIWES III	8	C	24 Weeks
Total		**15**		

*All credited in second semester of 400 level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
ELE 505	Artificial Intelligence and Engineering Applications	3	C	45	-
ELE 507	Digital Signal Processing and Applications	3	C	45	-
ELE 512	Industrial Electronics Design	3	E	45	
ELE 513	Embedded Systems Design and	2	E	30	-

	Programming				
ELE 519	Final Year Project I	2	C	15	45
ELE 529	Final Year Project II	3	C	-	135
Total		**16**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing[brainstorming and outlining], writing [paragraphing, punctuation and expression]. post- writing [editing and proofreading]. Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units: C, LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;

3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents
Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and

incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis anddeduction.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;

4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

ELE 101: Introduction to Electronics Design and Practice
(2 Units C: LH 15; PH 45)

Learning Outcomes
Upon the completion of the course, the student should be able to:
1. apply knowledge of mathematics, science, and engineering to the analysis and design of electrical circuits;
2. identify, formulate, and solve engineering problems in the area of circuits and systems;

3. use the techniques, skills, and modern engineering tools such as pSpice, workbench, necessary for electronics engineering practice;
4. function on multi-disciplinary teams through the electric circuits experiments and projects; and
5. design an electric system, components or process to meet desired needs within realistic constraints.

Course Contents

B**asic circuit laws:** Ohm's law, Kirchhoff's voltage and current laws; Nodes, Branches and loops, Series elements and voltage division, parallel elements and current division, Star-Delta transformation.
AC Fundamentals: Review of Complex Algebra, Sinusoids, Phasors, Impedance and Admittance, Series and parallel combination of Inductors and Capacitors, Mesh and Nodal analysis, RMS and Average values, steady-state analysis of series and parallel combination of RLC with sinusoidal excitation, Instantaneous power, Real, Reactive and Apparent power, Concept of Power factor, Frequency.
Network Theorems and Resonance: Superposition theorem, Thevinin's theorem, Nortorn's theorem, Maximum power transfer theorem, Reciprocity theorem, Resonance in Electrical circuits, Analysis of series and parallel Resonance.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes
At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents
Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modeling I (3 Units C: LH30; PH45)

Learning Outcomes

Students should be able to:

1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;

9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;

3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;

2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the student should be able to:
1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, -technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (3 UnitsC: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

ELE 305: Circuit Theory **(2 Units E: LH 30)**

Learning Outcomes

On the successful completion of this course students will be able to:

1. write circuit equations for a coupled-inductor system;
2. analyse circuits containing ideal transformers and autotransformers;
3. analyse three-phase wye- and delta-connected balanced circuits;
4. plot Bode diagrams from transfer functions for SISO circuits;
5. write behavioural descriptive equations for series- and parallel-resonant circuits in the time- and frequency domains;
6. use Fourier series techniques to analyse circuit responses to periodic signals; and
7. derive two-port parameters of circuits.

Course Contents

Three-phase balanced circuits and power; mutual inductance; Linear transformer, ideal transformer, autotransformer; Frequency response, transfer function, Bode plots; Series and parallel resonance in the frequency domain; Series and parallel resonance in the time domain; Fourier series in circuit analysis; Two-port parameters; Laplace transform circuit analysis.

ELE 313: Analogue Electronic Circuits **(3 Units C: LH 30; PH 45)**

Learning Outcome

Upon the successful completion of this course, students should be able to:

1. analyse single-stage amplifiers with BJTs and MOSFETs;
2. identify and analyse negative-feedback circuits;
3. analyse single- and second-order passive filters;
4. analyse single-, second-, and higher-order active filters;
5. analyse rectifiers, peak detectors, and oscillators; and
6. use pSpice to simulate circuits.

Course Contents

Review of Microelectronic Devices**:** Diode, BJT, JFET, and MOSFET**;** Large-signal behaviour and Small-signal models; Single-Transistor Amplifiers**:** Common-emitter/source, common-base/gate, and common-collector/drain; Biasing, small-signal gain, input resistance, and output resistance**;** Circuit simulation using pSpice**;** Multi-Transistor Amplifiers**:** Cascade, differential, and cascade**;** Biasing, small-signal gain, input resistance, and output resistance**;** Frequency Response**,** Gain/phase plots and Analysis**;** Negative Feedback: Effects on gain, input resistance, output resistance, noise, distortion, and bandwidth; Inverting and non-inverting op amps**;** Passive Filters and Active Filters: Low-pass, high-pass, band-pass, and band-reject**,** First-, second-, and higher-order**;** Non-linear Circuits**:** Rectifiers and peak detectors**,** Sinusoidal oscillators**,** Mono and bi-stable multivibrators**,** Waveform generators.

ELE 318: Digital Electronics (2 Units E: LH 30)

Learning Outcomes

Upon the successful completion of this course, students should be able to:

1. perform base 2, 8, 16 and BCD-code (binary-coded decimal) calculations;
2. design a minimal combinatorial logic circuit that solves binary logical tasks;
3. design a minimal sequential circuit that solves binary logical tasks;
4. describe the structure of a logic gate;
5. explain the principles of programmable circuits;
6. explain the principles of analog-to-digital (AD) - and digital-to-analog (DA) conversion;
7. design synchronous networks with sequential flow charts;
8. design sequential circuits for programmable logic device (PLD) circuits; and
9. programme a PLD type Field-Programmable Gate Array (FPGA).

Course Contents

Introduction to Computing Systems; Switch Design; Boolean Algebra; Gate Design and Simplification; Building Blocks; Number Systems and Arithmetic; Latches and Registers; Counters; State Machines; Memory; Datapaths; Introductory Assembly Programming.

Laboratory projects will include use of PC-based CAD environment that supports schematic capture, logic simulation, and HDL-based logic synthesis on FPGAs (field-programmable gate arrays). Small-scale integrated circuits will be used for early labs; HDL-based logic synthesis on FPGA-based design boards will be used for more advanced design implementations.

ELE 324 : Communication Principles (3 Units E: LH 45)

Learning Outcomes

On the successful completion of this course, students will be able to:

1. analyse communication systems in both the time and frequency domains;
2. describe the principles of amplitude modulated and angle modulated communication systems, and be able to analyse their performance in the presence of noise;
3. explain source coding and its relations to information theory, citing Shannon's theorem;
4. describe the principles of various digital modulation systems and their properties, including bandwidth, channel capacity, transmission over bandlimited channels, inter-symbol interference (ISI), demodulation methods, and error performance in the presence of noise; and
5. explain engineering fundamentals of photogeneration, photodetection and lightwave propagation for optical communications.

Course Contents

Models of telecommunication system. The concept of information volume. Characteristics of analogue audio and video signals. Analogue modulation techniques and their implementation: amplitude and angle modulation, Frequency Division Multiplexing. Digitization of analogue signals. Binary system. Arithmetic operations on binary numbers. Modulo 2 arithmetic. Pulse code modulation (PCM), sampling, quantization, coding. Delta and differential pulse code modulation. Synchronous and asynchronous, static and dynamic time division multiplexing. Plesio-synchronous digital hierarchy, primary group, secondary group, groups of higher levels. Synchronous digital hierarchy. Multiplexing PDH signals into SDH STM-1 transport module. Transmission media. Optical fibres: single mode, multimode. Optical cables. Wavelength division multiplexing (WDM): Dense wavelength division multiplexing (DWDM)

400 Level

ELE 403: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student will be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. Runge-Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation. MATLAB functions for numeric solution of linear and non-linear ODEs.

ELE 405: Engineering System Modelling and Simulation (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student will be able to:

1. comprehend the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems through available software;
2. explain different types of simulation techniques; and
3. simulate models for the purpose of developing and apply software.

Course Contents

Introduction: System, environment, input and output variables, State variables; Static and Dynamic systems; Hierarchy of knowledge about a system and Modeling Strategy.

Physical Modeling: Dimensions analysis; Similarity criteria and their application to physical models. Modeling of System with Known Structure: Review of conservation laws and the governing equation for heat, mass and momentum transfer; Deterministic model; distributed parametre models; lumped parametre models in terms of differential and difference equations; state space model, transfer functions block diagram and sub systems, stability of transfer functions, modeling for control. Neural Network Modeling of Systems; Neurons, architecture of neural networks, knowledge representation, learning algorithm. Multilayer feed forward network and its back propagation learning algorithm, Application to

complex engineering systems and strategy for optimum output. Modeling Based on Expert Knowledge; Fuzzy sets, Membership functions, Fuzzy Inference systems, Expert Knowledge and Fuzzy Models, Design of Fuzzy Controllers
Optimisation and Design of Systems: Summary of gradient based techniques: Non-traditional Optimisation techniques (1) genetic Algorithm (GA)- coding, GA operations elitism, Application using MATLAB. Simulation of Engineering Systems; Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems.

ELE 407: Data Communication and Networking (3 Units E: LH 30; PH 45)
Learning Outcomes
Upon the completion of this course, students should be able to:
1. describe the theoretical fundamentals of how the Internet works;
2. use a layered model to explain the primary functionalities of internetworking;
3. identify algorithms and functionalities to allow reliable data transport over an unreliable network;
4. explain the fundamental protocols in the Internet and apply them to new networks;
5. describe Software Defined Networking, fundamental concept and its impact on the Internet; and
6. explain the fundamentals of link layer protocols.

Course Contents
Introduction: network edge, end systems, access networks, links, network core, packet switching, circuit switching, network structure, delay, loss, throughput in networks, protocol layers, service models, Application Layer, Web and HTTP, Electronic mail, Domain Name System, video streaming and content distribution networks, Socket programming with UDP and TCP*, Transport Layer, multiplexing and demultiplexing, connectionless transport: UDP, principles of reliable data transfer, connection-oriented transport: TCP, principles of congestion control, TCP congestion control, Network layer: The Data Plane, control plane, Router architecture, IP: Internet Protocol, Generalized Forward and SDN, Network Layer: The Control Plane, routing protocols, intra-AS routing in the Internet: OSPF, routing among the ISPs: BGP, The SDN control plane, Link Layer and LANs, error detection, correction, multiple access protocols, data center networking, Wireless Networking, Wireless links, characteristics, IEEE 802.11 wireless LANs (Wi-Fi), Network Security, Message integrity, authentication, Securing e-mail, securing TCP connections: SSL, Firewalls and IDS.

ELE 411: Advanced Electronic Circuits Design (3 Units E: LH 30; 45)

Learning Outcomes
On successful completion of this course a student will be able to:
1. analyse and design analogue electronic circuits using a variety of techniques;
2. understand the theory of operation of the main components used in analogue electronic systems;
3. analyse and deign amplifiers, op amps circuits and filters;
4. understand the principles of feedback theory and the operation of oscillators; and
5. use the techniques, skills, and modern engineering tools such as pSpice, Electronic Workbench, necessary for engineering practice.

Course Contents
pSpice simulation; Design of BJT-based amplifier systems; Design of FET-based amplifier systems; Current-series feedback design; Current-series feedback design; Voltage-shunt feedback design; Differential amplifier; Op-amp IC applications; Positive feedback and

oscillator circuits; Advanced electronic laboratory skills (design, analysis, construction, and measurement of advanced analog electronic circuits using discrete devices (diodes, bipolar junction transistors, MOSFETs).

TEL 423: Power Electronics (2 Units E: LH 30)

Learning Outcomes:
On the completion of this course, students should be able to:

1. understand the principles of power control by switching; demonstrate the benefits of switched mode circuits; be familiarised with the commonly used semiconductor switching devices;
2. demonstrate a full understanding on several DC-DC converters; perform analysis on their operation principles; develop design equations for selecting their components;
3. be able to explain how the steady-state AC voltage and current are related to each other in power circuits using phasor analysis;
4. understand and be able to quantify active, reactive and apparent power;
5. comprehend the operation principles for several thyristors-based rectifiers; quantify the current harmonics and the average power drawn by a rectifier; and
6. understand the H-bridge based inverters and their several control methods; develop the skills in analysing the different modes of operations for the inverters; gain the understanding on how the power is delivered or absorbed by grid-connected inverters.

Course Contents
The basics of three-phase circuits, connections, voltage and current analysis and real and reactive power calculations; the fundamentals of electricity conversion from the form supplied by the source to the forms required by the load; power electronic conversion techniques, including the basic converters (DC-DC, AC-DC and DC-AC) and their power switching and control methods; the methods of circuit analysis applicable to switched mode circuits; essential properties of the relevant semiconductor devices; simple converters for practical applications. Characteristics of power devices; DC-DC converters; AC Current, Voltage and Power; AC-DC converters and Inverters (DC-AC converters).

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law **(2 Units C: LH 30)**

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/ancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

ELE 505: Artificial Intelligence and Engineering Applications (3 Units C: LH 45)

Learning Outcomes

Upon the completion of this course, the student shall be able to:

1. demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations;
2. apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning;
3. demonstrate awareness and good understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models;
4. demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool; and
5. demonstrate proficiency in applying scientific methods to models of machine learning.

Course Contents

Introduction to Artificial Intelligence: Intelligent Agents and Applications of Artificial Intelligence.

Knowledge Representation and Reasoning: Propositional logic, Theory of first order logic, Inference in First order logic, Forward and Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks.

Machine Learning: Supervised and unsupervised learning, Decision trees, Statistical learning models, Learning with complete data – Naive Bayes models, Learning with hidden data – EM algorithm, Reinforcement learning.

Pattern Recognition: Introduction, Design principles of pattern recognition system, Statistical Pattern recognition, Parametre estimation methods – Principle Component

Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

ELE 507: Digital Signal Processing (3 Units C: LH 45)

Learning Outcomes

On the successful completion of this course, the student should be able to:

1. specify the sampling, quantization, and signal conditioning requirements for a given DSP application;
2. identify components of a DSP hardware system and program a DSP processor in the C language;
3. estimate spectra of discrete-time signals using the fast Fourier transform (FFT) in MATLAB and implement the FFT on a DSP chip;
4. determine and interpret the z-domain transfer function of a discrete-time system and design discrete time filters in the z domain using the pole-zero method;
5. design finite impulse response (FIR) and infinite impulse response (IIR) discrete-time filters for lowpass, high-pass, bandpass, bandstop, and arbitrary frequency response applications;
6. implement digital filter designs in MATLAB and on a DSP chip; and
7. analyse discrete-time filter banks and multi-rate signal processing systems.

Course Contents

Review of discrete-time signals and systems with emphasis on sampling and quantization. Introduction to DSP hardware architecture, including fixed-point vs. floating-point processors and the multiply-accumulate unit. Convolution and spectral analysis using the discrete-time Fourier transform. The discrete Fourier transform, the fast Fourier transform (FFT), and use of the FFT for convolution and spectral analysis. Z- transforms, pole-zero analysis of discrete-time systems, and pole-zero-based digital filter design. Analysis of FIR and IIR discrete-time systems with emphasis on phase response. Design and implementation of FIR digital filters. Design and implementation of IIR digital filters. Introduction to multi-rate signal processing and filter banks.

ELE 512: Industrial Electronics Design (3 Units E: LH 45)

Learning Outcomes

Upon the successful completion of this course, students will be able to:

1. explain basic elements of Industrial motor control: determine the use of different control devices and motor starters;
2. understand fundamental elements of power electronics: diode-based rectifiers, harmonics and PF distortion, thyristor principles and control, tyristor-based rectifier and inverter;
3. explain the operation of cycloconverter; SCR-based converter and triggering range and firing angles;
4. analyse DC-to-DC switching converters, DC-to-AC switching converters and analyse PWM techniques in dc switching; and
5. understand electronic Control of DC and AC Motors.

Course Contents

Solid-state devices and circuits; Programmable controllers; Thyristors; Lasers; Fiber optics ; Power supplies; Op-amp circuits; Open- and closed-loop (feedback) systems; Input devices

;Output devices; AC and DC motors; Motor control devices; Robots and other motion control systems; Data communications.

ELE 513: Embedded Systems Design and Programming (2 Units E: LH 30)

Learning Outcomes

On the completion of the course, students will be able to:

1. analyse and explain the basic building blocks of embedded systems hardware;
2. identify relevant components and building blocks for embedded solutions;
3. evaluate different embedded system architectures;
4. describe the hardware and software architecture of processors used in embedded systems (2);
5. use embedded system development platforms and environments;
6. specify relevant embedded systems requirements such as memory, processor speed and energy consumption;
7. develop experience in assembler and C programming languages (5); and
8. build embedded system solutions with the help of common hardware interface units

Course Contents

Introduction to microcomputers and embedded systems: Processor architectures, microcontrollers used in embedded systems; CPU, memory and input output units; Interrupts; Introduction to hardware level programming of embedded systems: Programming in assembler, Programming in C, Development platforms for embedded software; Introduction to microcomputer interfaces: Digital I/O, Serial I/O, Timers, Analog-to-digital conversion, Pulse Width Modulation (PWM)

ELE 519 & 529: Final Year Project I & II (5 Units C: LH 15; PH 180)

Learning Outcomes

The student(s) will develop a technology and/or system to solve a known and significant electronic engineering problem and design and, where possible/practicable, build/produce/ manufacture some relevant new hardware/device(s) representing the solution using the skills acquired in the programme.

Course Contents

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the electronic engineering degree

Minimum Academic Standards

Equipment

List of Required New Laboratories and Equipment

S/N.	Laboratory/Workshop	Essential Equipment and Components
1	Basic Electrical Engineering Lab (Applied Electricity Laboratory)	Dual Power Supplies; Digital Multimetre, Various electronic components (ICs, BJTs, MOSFETs, Diodes, Resistors, Capacitors, Inductors, etc.). PCs loaded with software

		for electronic circuits simulation
2	Electronics and PCB Laboratory	PCs with specialised electronics design software, Oscilloscopes (Digital and Analogue), Function generators, Analogue training kits, Digital training kits, Breadboards. Various electronic components (ICs, BJTs, MOSFETs, Diodes, Resistors, Capacitors, Inductors, etc.). PCs loaded with software for electronic circuits simulation PCB making machine including: Art Work Film Maker, Curing Machine (Oven), Dip Coating Machine, U.V Exposure Unit, Etch Etching Machine, Chemicals for PCB Processing
3	Digital Electronics and Microprocessor Lab	Dual Power Supplies, Digital multimetre, Digital IC Testers, Microprocessor kits, EPROM Programmer/Eraser, Interfacing cards for Process applications, Micro-controller kits with PC Interface, Texas Instruments DSP Kits**,** Analog Devices DSP, PCs with simulation softwares (Proteus Pro, MATLAB + relevant tool boxes)
4	Data Communication Lab	Function Generators, Oscilloscopes (Analogue and Digital Storage), Signal Generators, Various Analog /Digital Study and Trainer Kits, Fiber Optic Trainer Kits, Digital Communication Training kits, Amplitude Modulation/Demodulation Trainer Frequency Modulation/Demodulation Trainer, Pulse Code, Network analyseanalyser and Spectrum AnalyseAnalysers, SWR Metre, Power metre, Optical power metre, Industrial standard simulation tools such as OPNET, MATLAB for signal processing.
5	Data Communication and Networking Lab	Computer System with latest specifications, 19" Rack, Port Switch, Windows 2003 Server or Latest version (10 user License), Red hat Linux (20 user License), Data Backup utility Software, Data Communication Trainer Board, LAN Trainer System, Trainer Boards to study Frequency Division Multiplexing/ Demultiplexing and Time Division Multiplexing/ Demultiplexing, Digital Multimetre, Wireless access points, Wi-Fi LAN Cards, Network/Bandwidth management Software (Cybernetra or Equivalent), Trainer Board to study Working of MODEM, LAN Cable tester, Crimping tool, Display Boards of various types of cables and connectors used in Computer

		networks, Online UPS (5 KVA), Network Printer, Antivirus (10 user License)
	Embedded Systems Lab	Microcontroller kits, Target board, DSP Starter kits, Modeling and Simulation software (MATLAB), PC-Based Oscilloscope, Linux Single Board computer, FGPA Evaluation kit, Xilinx Embedded Development kit
	Instrumentation and Control Lab	Workstations equipped with LABVIEW and MATLAB for designing and simulating analog and digital controllers; transducers and trainers.
	Final Year Project Lab	

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;

2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library that is well equipped with specialized books and journals in both physical collections and E-collections (E-Resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribe repository of:

1. Institutions (national and international)
2. Open access sources
3. Professional Bodies' e-learning platforms
4. Relevant international organizations

The library must also have adequate facilities for the following:
1. reading;
2. provisions for lending; and
3. reservation unit for specialized materials.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

The requirements for office accommodation are:

1.13 academic offices on paper

2. 1 professorial type in the department. Size: each of the office is about 13.5 m

S/N	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves.

B.Eng. Electrical and Electronics Engineering

Overview

Electrical and Electronics engineers are involved in channelling natural resources into various end-uses such as in heating, lighting, home appliances, consumer products, computing, sensing, control, and communication systems. They contribute to the development of systems and devices for power, instrumentation, measurement, communication engineering, management, manufacturing, transportation, etc. They are primarily concerned with the processes of generation, transmission, transformation, control, and utilization of energy and/or information.

The curriculum exposes students to the breadth of electrical and electronics engineering and allows them to pursue electives in several areas including electrical circuits, electronics, electrical power systems, communication systems, signal processing, control systems, electromagnetics, optics and optical devices, and computer engineering. Hence, the students are expected to take courses in the following areas:

1. electrical circuits and electronics provide study of basic electrical devices – energy sources, resistors, inductors, capacitors, diodes, and transistors – and their interconnection in operational networks. Circuit analysis and design techniques cover both analogue and digital applications;
2. power systems emphasize the design and applications of motors, generators, transformers, distribution systems, high-voltage devices, and power electronics;
3. control systems emphasize the design and application of circuits and systems to automatically monitor and regulate operation of devices, machines, and processes. Advanced technologies using digital control, intelligent processing, neural networks, and programmable logic controllers are included;
4. communication systems and signal processing cover concepts required for the characterization and manipulation of information-bearing signals, modulation systems, wireless networks, image processing, and signal detection software and hardware. These courses provide instructions in the interaction, propagation, and transmission of high-frequency waves and signals through space and in conductors. Topics include grounding and shielding, antennas, microwaves, and systems; and
5. optics and optical devices provide a study of solid-state materials, electronic devices, and optoelectronics. Applications are in micro-fabrication, telecommunications, computing, instrumentation, lasers and fibre optics, sensing, and smart technologies.

Philosophy

The general philosophy of the Electrical and Electronics Engineering (EEE) programme is to produce graduates with high academic and soft skills competence, capable to adequately participate, transform and impact on the Engineering and allied industries in consonance with National and Global community values, including National Policy on Industrialization and Self-Reliance. The programme therefore aims at:

1. exploring the importance of efficient and sustainable solutions for Electrical and Electronics Engineering challenges, such as achieving sustainable electricity generation, secure distribution, and intelligent communication systems;
2. providing ample opportunity for practical application and project work as emphasized throughout the course; and

3. producing EEE graduates of high academic and ethical standards with adequate practical exposure for self-employment as well as being of immediate value to industry and the community in general.

Objectives

The objectives of the programme are, among others, to:

1. apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the solution of Electrical and Electronics Engineering related problems;
2. design solutions for Electrical and Electronics Engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, environmental and other ethical considerations;
3. conduct investigations of complex problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;
4. create, select and apply appropriate techniques, resources and modern Engineering and IT tools: including prediction and modeling, to complex Engineering activities, with an understanding of the limitations;
5. function effectively both as an individual and as a team member or leader in diverse and in multi-disciplinary settings;
6. communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, as well as, give and receive clear instructions;
7. demonstrate knowledge and understanding of Engineering and Management principles and equally apply them in managing multi-disciplinary projects;
8. nurture partnership between the institution and industry for effective programme delivery;
9. create awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
10. develop entrepreneurial skills and knowledge, in addition to adequate training in human and organisational systems with the spirit of self-reliance so that they can set up their own businesses.

Employability Skills

Electrical and Electronics Engineers to be produced are expected to be equipped, among others, with the following skills:

1. Define, investigate, and analyze electrical and other borderline engineering problems;
2. Design or develop creative and innovative solutions to electrical engineering and related problems;
3. Evaluate the outcomes and impacts of electrical and electronics engineering activities;
4. Take personal responsibility for making decisions on the part, or all, of electrical and electronics engineering activities;
5. Initiate, plan, lead or manage electrical and electronics and related engineering activities;
6. Exercise sound judgment in the course of his/her work;
7. Communicate efficiently, honestly and effectively with others in the course of his engineering work; and
8. Develop and operate within a hazard and risk framework to evaluate outcomes and impacts of electrical and electronics engineering activities.

21st Century Skills

The programme has emphasised the following 21st century skills:

1. problem solving;
2. collaboration (team work);
3. digital literacy;
4. creativity and innovation;
5. information literacy; and
6. critical thinking through collaborative research projects and group assignments.

Unique Features of the Programme

Electrical and Electronics Engineering is at the core of the modern world, from power systems, computers to digital circuits, photonics and a wealth of electrical and electronic devices. This programme offers a unique combination of complementary knowledge and skills in electrical power systems, electronics and 21st century skills in artificial intelligence (AI), machine learning (ML), big data, *et cetera*, thus allowing graduates to pursue a wide range of engineering interests and strategic career choices. The programme will produce graduates with knowledge to provide society with the complex electrical and electronic systems, as well as the software and hardware needed or required to operate the systems. Unlike the earlier curriculum, this one is more student-centered to unleash their power of self-confidence and critical thinking.

Special Job Opportunities of the Programme

Electrical and Electronics Engineers are involved in the design and development of electrical and electronics equipment and in the improvement of the capabilities of existing electrical and electronics equipment. There is a gamut of very broad opportunities for electrical and electronics engineers. They can also find themselves in software companies involved in the design, manufacture and operation of various engineering devices. The career scope in this field at both national and international levels is excellent.
Major companies recruit skilled and capable Electrical and Electronics Engineers to accelerate their growth. However, graduates should also acquire practical knowledge in laboratory sessions and practicals in order to be successful in the field. Interested graduates can also progress to the postgraduate level to obtain Masters and Doctorate degrees in any of the specialised areas of Electrical and Electronics Engineering, particularly if they desire to become lecturers and professors in the future. The graduates therefore can find themselves comfortably fixed in many types of work. Some of the job profiles which Electrical and Electronics Engineers usually work after graduation are as detailed below.

Job Title	Job Description
Design Engineer	Development of ideas for new products and the systems used to manufacture them. Such systems include consumer electronics (TV, VCRs, CD players, stereo equipment, gaming devices); power generation, transmission and distribution; computer equipment (motherboards, printers, scanners, processors, monitors); communications equipment (transmitters and receivers, networks)
Electronics Engineer	Design and creation of everyday devices such as mobile phones and computers.

Manufacturing Engineer	Plant Engineering: servicing and offering support in industrial environment; Power Engineering: safe and reliable power delivery; Control Engineering: design, programming, support to industrial automation; Information Systems Engineering: support to manufacturing processes
Quality Control Engineer	Designing and overseeing the production of various types of complex systems and equipment.
Analysis and Test Engineer	Plan, design, and evaluate products, as well as collaborating with the production department. Technical Service Engineering: troubleshooting, maintenance and repair; Product Testing for quality, safety, performance of equipment
Software Engineer	Develop, test and improve systems and components including circuit boards, processors, and other devices.
Project Engineer	Planning, implementing, resource forecasting and other technical activities of the project.
System Design Engineer	To research, study and develop new ideas for new products and the system to manufacture them.
Research Engineer	Analysing, implementing and testing the product developed in the laboratory
Field/Sales Engineer	Technical Service Engineering: troubleshooting, maintenance and repair; Product Testing for quality, safety, performance of equipment
Research and Development (R&D)	Product Development; Research to discover/develop new technologies; Training

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

3. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
4. Direct Entry(DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior Secondary Certificate Examination (SSCE) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holders of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree.

Candidates admitted through the UTME mode shall have registered for at least 150 units of courses during the 5-year degree programme. Candidates must have registered and passed all the compulsory courses specified for the programme.

The EEE programme shall be run on the modularised Course Unit System. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credits are weights attached to a course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures or three hours of laboratory/studio/workshop work per week per semester of 15 weeks.

The determination of the class of degree shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme. The CGPA shall be used in the determination of the class of degree

Global Course Structure

Level	GNS/GST	Basic Science	(GET)	Departmental (EEE)	SIWES	Total Units
100	4	16	3	4	-	27
200	4	-	25	3	3*	33
300	4	-	18	0	4*	26
400		-	-	0	8*	08
500		-	5	6	-	11
Total	**12**	**16**	**51**	**26**	**15***	**105**

* All credited in the 2nd Semester of 400-level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	30	-
CHM 101	General Chemistry I	3	C	45	-
CHM 102	General Chemistry II	3	C	45	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
EEE 102	Introduction to Electrical and Electronics Engineering	2	C	30	-
	Total	**27**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human	2	C	30	-

	Existence				
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 203	Engineering Graphics and Solid Modeling II	2	E	15	45
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 207	Applied Mechanics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
EEE 202	Applied Electricity II	3	C	30	45
EEE 204	Electrical Engineering Materials	3	E	45	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**30**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing & Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45-
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
EEE 311	Electric Circuit Theory I	2	E	30	-
EEE 321	Analogue Electronic Circuits I	2	E	30	-
EEE 322	Digital Electronic Circuits	2	E	30	-
EEE 324	Electromagnetic Fields and Waves I	2	E	30	-
EEE 326	Electric Circuit Theory II	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**22**			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH	PH
GET 299	SIWES I	3*	C	9 weeks	
GET 399	SIWES II	4*	C	12 weeks	
GET 499	SIWES III	8*	C	24 weeks	
	Total	**15***			

* All 15 units credited in the 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
EEE 593	Final Year Project I	3	C		
EEE 594	Final Year Project II	3	C		
	Total	**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional). grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities: pre-writing (brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the Judiciary in upholding fundamental human rights

7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;

3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost.
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take;and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation work spaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility;

thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

EEE 102: Introduction to Electrical and Electronics Engineering
(2 units C: LH 15)

Learning Outcomes
Students will be able to:
1. comprehend the duties and functions of an Electrical and Electronics Engineer (EEE);
2. state the requirements for the profession and career opportunities;
3. state the careers related to EEE; and
4. explain the future of EEE.

Course Contents

History of Electrical Engineering. Evolution of EEE. Duties of EE Engineers. Areas of specialisation and work environment. Skill requirements (soft and hard). Qualities for EE Engineers. Careers related to EEE. Typical course modules. Job outlook/opportunities for EE Engineers. Future of EEE. Professional registration (NSE, COREN, IEEE, IET, etc.). Passive components (R, L, C, transformers): descriptive features, including values and colour codes, uses in electrical circuits.DC and AC signal parameters

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Content

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
5. explain the basic a.c. circuit theory and
6. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 203: Engineering Graphics and Solid Modeling II (3 Units E: LH 30; PH 45)

Learning Outcomes

Students should be able to:

1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wet in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs and others;
6. perform calculations based on principles of mass, momentum and energy conservation;

7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 207: Applied Mechanics (3 Units C: LH 45)

Learning Outcomes

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke’s and Green’s theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;

2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

EEE 202: Applied Electricity II **(3 Units C: LH 45)**

Learning outcomes
Students will be able to:
1. differentiate between various d.c. and a.c. machines;
2. explain the principles of operation of machines;
3. explain the operation of basic semiconductor devices and their basic applications; and
4. explain the principle of operation of communication systems with examples.

Course contents
Basic machines – DC, synchronous alternators, transformers, equivalent circuits. Three-phase balanced circuits, PN junction diode, BJTs, FETs, thyristors, communications fundamentals, introduction of TV, Radio, Telephone systems.

EEE 204 Electrical Engineering Materials **(3 Units E: LH 45)**

Learning Outcomes
Students will be able to:
1. discuss electron conduction mechanisms in semiconductors;
2. explain transport phenomena in semiconductors; and
3. describe semiconductors device fabrication techniques.

Course contents
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy bands in conductors, insulators and semiconductors: electrons in metals and electron emissions; carriers and transport phenomena in semiconductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

300 Level

GST 312: Peace and Conflict Resolution **(2 Units C: LH 30)**

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government,

community leaders.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies.

GET 301: Engineering Mathematics III **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;

5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; trans-esterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (3 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

New

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

EEE 311: Electric Circuit Theory I (2 Units E: LH 30)

Learning Outcomes

Students will be able to:

1. state, explain and apply circuit theorems to d.c. circuits;
2. obtain the network response to certain input signals using phasor notations and diagrams;
3. state and apply Laplace transforms to solve passive circuits; and
4. plot Bode diagrams of a given transfer function.

Course Contents

Passive circuit elements: R, L, C, transformers; circuit theorems: Ohm's, KVL, KCL, loop current, node potential, superposition. Network response to step, ramp and impulses. Network functions: response to exponential, sinusoidal sources. Laplace transform and transfer functions: pole-zero configuration and application in solving circuits, resonance; two-port analysis and parameters.

EEE 321: Analogue Electronic Circuits I **(2 Units C: LH 30)**

Learning Outcomes

Students will be able to:

1. classify, describe and discuss the principles of operation and applications of FET and BJT; and
2. calculate amplifier parameters; and design simple amplifiers using BJT and FET with given specifications.

Course contents

Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi-stage amplifiers using BJTs and FETs.

EEE 322: Digital Electronic Circuits **(2 Units E: LH 30)**

Learning Outcomes

Students will be able to:

1. classify, describe and discuss the various logic gates and flip-flops and multivibrators; and
2. design simple logic and sequential circuits using logic gates and flip-flops.

Course contents

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean algebra. Simplification of Logic expressions using Karnaugh Method. Design of combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counter. Registers and timers. Switching and wave shaping circuits. Generation of non-sinusoidal signal (multivibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc). Sequential circuits. Introduction to microprocessors.

EEE 324: Electromagnetic Fields and Waves I **(2 Units E: LH 30)**

Learning Outcomes

Students will be able to:

1. state and explain the various electromagnetic laws;
2. derive and explain Maxwell's equation in rectangular coordinates; and
3. explain wave propagation mechanism in conductors and unbounded dielectric media.

Course Contents

Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws. Electrostatic fields due to distribution of charge. Magnetic fields in and around current carrying conductors. Time-varying magnetic and electric fields. Conduction and displacement current. Maxwell's equations (in rectangular co-ordinates and vector-calculus notation). Derivation of Maxwell's equations, electromagnetic potential and waves. Poynting vector, boundary conditions. Wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media.

EEE 326: Electric Circuit Theory I (2 Units E: LH 30)

Learning Outcomes

1. At the end of the course, students will be able to:
2. analyse on-linear circuits using approximation methods;
3. state the conditions for realisability of transfer functions;
4. design/synthesize RL, RC, LC and RLC circuits from given transfer functions; and
5. design passive and active filters from transfer functions and performance specifications.

Course Contents

Non-linear circuit analysis. Network functions, Locus diagrams. Circuit synthesis: realisability criteria, Foster and Cauer syntheses of RC, RL, LC and RLC circuits. Filters: design, operation, low, high, bandpass. Butterworth and Chebychev filter design. Active network analysis and synthesis.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

New

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

EEE 593/594: Final Year Project (6 Units C: LH 270)

Learning Outcomes

The student(s) will develop a technology and/or system to solve a known and significant electronic engineering problem and design, and if possible/practicable, build/produce/ manufacture some relevant new hardware/device(s) representing the solution using the skills acquired in the programme.

Course Contents

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the electronic engineering degree.

Minimum Academic Standards

Equipment

List of Laboratories

Control and Instrumentation Laboratory
Electronics Laboratory
Microprocessor and Digital System Laboratory
Computer Engineering Laboratory (Hardware and Software)
Communication Laboratory
Energy Laboratory
Electric Power/Machine Laboratory

Equipments

Digital logic analyser
Smart Logic Design Experimental Kit
Digital Logic Circuit Design Experiment Kit Microcomputer Trainer
AM/FM Transmitters and Receivers System Trainer
Fiber-optic Transmission Training System
GSM/GPS Experimental Trainer
Programmable Logic Controller System Trainer
Digital 3 Phase Power Analyser with SD Card Real time data Recorder
Digital Storage Colour Display 2/4-Channel Oscilloscope
Arbitrary waveform and Digital Synthesised function Generator

Digital spectrum Analyser (9kHz -3GHz)
Instrumentation Trainer using Transducers Complete Set
Digital Communication System Trainer
Analog Communication System Trainer
Solar Power System Training kit
Electrical and Electronic System Trainer
Single Phase Transformer System Trainer
3- Phase Transformer System Trainer
Power Electronic Training System
Colour TV Trainer
Programmable Dual output DC Power Supply Units (different ranges)
Variable Transformer
PA (Public Address) System Trainer
Portable Wind Power Generator Training Kit Universal EPROM Programmable (48 Pins)
Bench Digital Multi-metre digit (various digit ranges)
High voltage Insulation tester variable digital type up l0kV Power factor meter
Frequency metre
Digital energy metre
Digital watt metre, single phase
Digital watt meter, 3-phase
Semi-conductor curve tracer
Advanced frequency modulation and demodulation train
Digital transistor tester
Decade resistance box
Decade capacitance box
Decade inductance box
3-phase variable inductance load
3-phase variable capacitance load
3-phase variable resistance load
Digital multifunction documenting calibrators
Digital function generator (different frequency ranges)
Electrical Tools Box
Digital Stroboscope
Digital DC A ammeters multi-range
Digital AC Volt meters Multi range
Digital DC Volt meters Multi range
Digital DC Volt meters Multi range
Digital Damp meter
Standard Digital Earth Loop/PSC/Tester
Photo/contact Tachometer
LCD Display 3-Phase Rotation Tester
Rheostat (different ranges)
Wheatstone bridge
Portable DC Potentiometer
Analogue dual-trace Oscilloscopes (different frequency ranges)
Signal Trace/injector
Digital RF Signal Generators
Klystron Microwave Trainer complete set
Antenna Lab Trainer complete set
PCB Fabrication Equipment complete set
Standard Analogue Multimeters
AVO meters

Electric power transmission training kit

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library that is well equipped with specialized books and journals in both physical collections and E-collections (E-Resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribe repository of:

1. Institutions (national and international)
2. Open access sources
3. Professional Bodies' e-learning platforms
4. Relevant international organizations

The library must also have adequate facilities for the following:

1. Reading
2. Provisions for lending
3. Reservation unit for specialized materials.

Classrooms, Laboratories, Workshops, Clinics and Offices

NUC recommended minimum physical space requirements are provided in the Table below:

Space	m^2
Provost's Office	18.50
Dean's Office	18.50
Head of Department's office	18.50
Professor's Office	18.50
Tutorial Teaching Staff's Office	13.50
Other Teaching Staff office Space	17.00
Technical Staff Space	17.00
Secretarial Space	17.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space/per Student	1.85
Drawing Office Space (A.O. Board) per student	4.60
Drawing Office Space (A.I. Board) per student	3.70
Laboratory Space	7.50

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Environmental Engineering

Overview

Environmental engineers are concerned with minimising the impacts of human activities on the local, regional, and global environment and concurrently improving standard of living. Towards preserving environmental and public wellbeing, the programme exposes students to a strong background in the fundamental earth sciences to understand complex environmental problems and design appropriate engineering solutions to them. As problem-solvers for something as diverse as "the environment," environmental engineers also need to understand the most current technologies used in practice and have a desire to maintain a high level of learning in this rapidly evolving and developing field. Environmental engineering draws across all disciplines of science and social science in handling the following key areas of emphasis in the programme: water and wastewater resources engineering; Geo-environmental engineering; air pollution and control; environmental chemistry and processes; and environmental Microbiology and Processes.

Primary areas of specialisation are:

1. air pollution and emission control;
2. solid and hazardous waste management;
3. natural systems modeling;
4. natural resource management;

~~5.~~ water and waste water treatment;

~~6.~~ Water resources ~~(~~control and use of water, focusing on flood control, irrigation, raw water supply, and hydroelectric power applications~~);~~

7. environmental noise and vibrations control; and
8. environmental protection.

Philosophy

The philosophy of the programme is to train environmental engineers who will apply technical understanding of environmental systems, systems engineering, and science to develop strategies to protect human and environmental health and design sustainable systems based on current technologies. They will be equipped to address issues at the local or global level, such as unsafe drinking water, air quality, and industrial hygiene and sustainability. The programme is focused on educating the next generation of environmental engineering professionals that will work in industries and government establishments, equipped with leading-edge knowledge. The programme is therefore committed to providing an excellent undergraduate program in a fostering learning environment that enables acquisition knowledge and development of the necessary skills for successful professional careers.

Objectives

Environmental engineers are called upon to understand, arrange, and manipulate the biological, chemical, ecological, economic, hydrological, physical, and social processes that take place in the environment to balance the material needs with human impacts on the environment. The objectives of the programme therefore are to produce graduates who will:

1. have confidence in their capabilities;
2. not only have the knowledge but also have the know-how;
3. be competent in the use of modern technologies and software in solving current problems;

4. assume leadership positions and contribute to understanding problems and the design, construction, and operation of solutions to societal problems involving environmental systems; and
5. demonstrate in their professional practice, strong technical abilities and advance in careers in environmental engineering and related disciplines.

Employability Skills

Environmental Engineering graduates' career opportunities cover the spectrum of private industry, public agencies, non-governmental organisations (NGOs), and educational institutions. Environmental engineers may work as designers, planners, operators of pollution control facilities and water supply systems, educators, consultants to private and public businesses, business owners, government regulatory agency officials, or even as environmental legislators

Graduates will be in high demand in this dynamic and evolving discipline to address global issues like climate change, sustainability, and water security across a range of industries such as:

1. water and wastewater treatment;
2. air pollution and emissions control
3. solid and hazardous waste management and recycling;
4. natural resource management;
5. environmental protection;
6. engineering consultancy;
7. government departments - local, state, and federal; and
8. resources - mining, oil, and gas.

The degree awarded in Environmental Engineering will equip our students with the skills and professional attributes that employers will value.

21st Century Skills

These skills emanate from the graduates' knowledge in social sciences, sciences, and thorough training in engineering principles are:

1. critical thinking/problem-solving/ decision making and the use of modern analytical and digital tools;
2. Creativity and innovation;
3. Collaboration (team work);
4. Communication;
5. Information literacy;
6. Citizenship (local and global); and
7. Life long Learning / metacognition.

Unique Features of the Programme

Environmental engineers find ways to keep nature less polluted, while environmental health engineers try to halt harmful environmental effects on human health. This programme in Environmental Engineering takes a broad view by merging both disciplines to solve environmental and public health problems. In addition to traditional fields such as water safety, groundwater protection, wastewater treatment, reduction of indoor and outdoor air pollution, and solid and hasardous waste disposal and clean up, this programme includes fields such as sustainability, climate change, ecology, epidemiology, genomics and evolution of infectious disease, to integrate engineering with human health, green design and pollution prevention, carbon sequestration and climate changes, and the development of alternative energy. The program also stresses analytical skills, modelling, and fieldwork in air pollution and environmental noise control in addition to traditional laboratory courses. In addition, courses such as Engineering Drawing and Modelling, Data Analysis using statistical software 'R', Renewable Energy Systems and Technology, Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies, GIS and Remote Sensing distinguish this programme.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	General Studies Courses		Basic Sci	Faculty GET	Dept. (CEE/ EVE)	SIWES*	Total
	GST	ENT					
100	4	0	16	3	2	-	25
200	2	2	0	23	6	3	32
300	2	2	0	18	13	4	31
400	0		0	0	3	8	8
500	0		0	5	4	-	9
Total	**8**	**4**	**16**	**49**	**30**	**15**	**105**

*Not included in NUC CCMAS 105 units component

100 Level

Course code	Course title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	45	-
CHM 102	General Chemistry II	2	C	45	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	45	-
MTH 102	Elementary Mathematics II	2	C	45	-
PHY 101	General Physics I	2	C	45	-
PHY 102	General Physics II	2	C	45	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
EVE 101	Environmental Engineering Fundamentals	2	C	30	-
	Total	**25**			

Note: C = Compulsory; LH = Lecture Hours per semester PH = Practical Hours per semester

200 Level

Course code	Course title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45

-GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing & Software Engineering	3	C	30	45
GET 207	Engineering Graphics & Solid Modelling II	2	C	15	45
EVE 202	Environmental Engineering Chemistry	2	E	30	-
EVE 203	Environmental Engineering Microbiology	2	E	30	-
*GET 299	SIWES I	3	C	9 weeks	
	Total	**29**			

300 Level

Course code	**Course title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	
GET 304	Engineering Communication, Technical Writing & Presentation	3	C	45	-
GET 305	Engineering Statistics & Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems & Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning & Convergent Technologies	3	C	45	-
CEE 301	Fluid Mechanics	3	C	30	45
CEE 303	Engineering Geology	2	E	15	45
CEE 304	Civil Engineering Materials	2	E	30	-
CEE 305	Soil Mechanics I	2	E	15	45
EVE 301	Principles of Engineering Survey	2	E	15	45
EVE 302	Risk Assessment	2	C	30	-
*GET 399	SIWES II	4	C	12 Weeks	
	Total	**27**			

400 Level

Course code	**Course title**	**Units**	**Status**	**LH**	**PH**
EVE 401	Fundamentals of GIS & Remote Sensing	3	E	40	45

GET 499	SIWES III	8	C	24 Weeks	
	Total	**0**			

***SWEP & Student Industrial Work Experience Scheme (SIWES)**

Course code	Course title	Units	Status	LH	PH
GET 299	SIWES I: SWEP	3	C	9 Weeks	
GET 399	SIWES II	4	C	12 Weeks	
*GET 499	SIWES III	8	C	24 Weeks	
	Total	**7**			

*All credited in second semester of 400 level

500 Level

Course code	Course title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
EVE 501	Water Treatment & Supply	2	C	30	-
EVE 502	Wastewater Treatment	2	C	30	-
	Total	**9**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional). grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing(brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures;peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;

5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum; and
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;

5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents
Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

EVE 101: Environmental Engineering Fundamentals (2 Units C: LH 30)

Learning Outcome

At the end of this course, the students should be able to:

1. acquire the fundamental principles that serve as the foundation for the entire field of environmental engineering;
2. explain how these fundamental principles are applied to water treatment, wastewater treatment, air quality, and solid wastes; and
3. describe mass and energy balances, chemical reactions, environmental regulations and policy, pollution prevention and risk assessment.

Course Contents

Introduction to environmental science. Ecosystem's considerations, food chain, natural decomposition, recycling. Environmental problems and impact of engineering activities. Various modes of pollution - water, air, and soil contamination, noise pollution; pollution measurement, and quantification. Water and waste-water physical, chemical, and biological characteristics; turbidity and colour, dissolved oxygen, hardness, pH, alkalinity, organic content, sampling and analysis, chemical and biochemical oxygen demand. Basic processes of treatment: flocculation and coagulation, sedimentation, filtration. Mass and energy balances, chemical reaction engineering. Environmental regulations and policy, pollution prevention, risk assessment.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 204: Student Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-v-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;

5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;

5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development projectthrough practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

EVE 201: Engineering Graphics and Solid Modelling II (2 Units C: LH15; PH 45)

Learning outcomes

At the end of this course, the students should be able to:

1. use projections to prepare a detailed working drawing of objects and designs;
2. gain skills in parametric design to aid their ability to see the design in the optimal specification of materials and systems to meet needs;
3. analyse and optimise designs based on strength and material minimisation;
4. Identify the need for the theoretical perspectives that create the basis for the analyses that are possible in design and optimisation, and recognise/ the practical link to excite their creativity and ability to innovate; and
5. translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views, and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface, and shell modeling. Faces, bodies, and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries, and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting, and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

EVE 202: Environmental Engineering Chemistry (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define relevant chemistry terminologies and their applications; and
2. acquire basic knowledge of chemistry needed to understand environmental concepts.

Course Contents

Stoichiometry and concentration. Atomic structure and chemical bonding. Acids, Bases, Salts, Metals. Changes of state, Solutions and equilibriums. Electrochemistry and corrosion. Organic chemistry, Biochemistry. Mass energy transfer and material balances. Quantitative variables governing chemical behaviour in environmental systems. Thermodynamics and kinetics of acid/base, coordination, precipitation/dissolution, and redox reactions. Organic chemistry nomenclature and pesticides.

EVE 203: Environmental Engineering Microbiology (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the functioning of microorganisms;
2. appreciate the role microorganisms play in many natural and engineered systems;
3. relate microbial activities to the treatment of water, wastewater, and solid waste; and
4. relate the role of microorganisms in diseases.

Course Contents

Structure and metabolism of cells (cell structure, cell growth kinetics, and genetics) and micro-organisms. Monitoring methods for pathogens and indicator organisms. Application of microbial knowledge in the natural environment (self-purification, biodegradation, biodeterioration, ecotoxicity). Introduction to ecology: Ecosystems, population dynamics, environmental cycles; human impact on ecosystems. Roles of microorganisms in wastewater treatment, anaerobic digestion of municipal sludges, stream self-purification, and degradation of water quality in drinking-water systems. Disinfection of wastewater and drinking water to remove viruses, bacteria and protozoa that cause waterborne diseases.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the student should be able to:
1. the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;

2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual demonstrate property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (3 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

CEE 301: Fluid Mechanics (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe boundary layer theory and state its applications in pipe and open channel flows;
2. analyse and design pipe network systems;
3. explain unsteady flows in pipes and open channels;
4. analyse and design of open channel for rigid and non-rigid flows; and
5. explain the use of hydraulic structures.

Course Contents

Fluid Boundary Layer theory. Steady pipe flow covering minor and major energy losses in laminar and turbulent flows. Pipe systems and network analysis. Pressure transients in pipelines. Uniform open channel flow covering the design of rigid and non-rigid boundary channels. Non-uniform open channel flow including - specific energy and critical flow, transition; water surface profiles in gradually varied flow and computer applications. Unsteady open channel flows. Hydraulic structures such as weirs, culverts, overflow spillways, and energy dissipators.

CEE 303: Engineering Geology **(2 Units E: LH 15; PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. plan subsurface exploration;
2. acquire the fundamental knowledge engineering geologic characterization of soil and rock types especially in Nigeria;
3. prepare soil profile during soil investigations;
4. apply geological knowledge in the siting of water, wastewater, roads, and dams and
5. prepare and interpret engineering geology report.

Course Contents

Basic principles of physical and structural geology with emphasis on topics related to civil engineering - the study of minerals, rocks and soil types, load formation, techniques of air-photo interpretations, and geological mapping. Introduction to geology of Nigeria. Application of geological principles to engineering and environmental problems such as water supply, site investigation - dams, geologic hazards, slope processes, earthquakes, subsidence, and the engineering properties of geologic materials. Preparation and interpretation of engineering geology report. This course should be supported with laboratory on basic geologic identification and mapping techniques.

CEE 304: Civil Engineering Materials **(2 Units E: LH 30)**

Learning Outcomes

A t the end of this course, the students should be able to:

1. explain the suitability for use in Civil Engineering Materials, the concepts of concrete, structural steel and other important structural metals such as timber and masonry.
2. conduct tests of engineering properties of Civil Engineering materials and utilize these for quality control;
3. describe the limitations of these materials under various uses; and
4. characterise some of the variability and uncertainty associated with these materials.

Course Contents

Concrete technology – types of cement, aggregates – properties. Concrete mix, design, properties, and their determination. Steel technology – production, fabrication, and properties: corrosion and its prevention. Tests on steel and quality control. Timber technology – types of wood, properties, defects, stress grading. Preservation and fire protection, timber products, rubber, plastics: Asphalt, tar, glass, lime, bricks, Applications to buildings, roads, and bridges.

CEE 305: Soil Mechanics I **(2 Units E: LH 15; PH 45)**

Learning Outcomes

At the end of this course, the students should be to:

1. measure soil properties in the laboratory;
2. interpret and summarise data soil classification;
3. determine the optimum conditions for compaction of soils and the ultimate amount achievable; and
4. estimate the settlement of soils due to compaction and consolidation.

Course Contents
Mineralogy of soils. Soil structures. Formation of soils. Soil classification. Engineering properties of soils. Soil in water relationship – void ratio, porosity, specific gravity, permeability, and other factors. Atterberg limits – particle size distribution. shear strength of soils, Mohr's stress circle. Compaction and soil stabilization. Settlement. Theory of consolidation. Laboratory work.

EVE 301: Principles of Engineering Survey (2 Units E: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. describe the principles and scope of surveying and geo-informatics;
2. use survey instruments to carry out basic measurements like distance, angles, heights, and coordinates;
3. acquire the skills to process field survey data for the preparation of a large-scale topographic map; and
4. interpret and analyse information on survey plans/maps for planning purpose.

Course Contents
Introduction to the use of basic surveying instruments: (Tapes, Theodolites, Total stations, GPS, and Levels). General principles involved in basic survey measurements: Control and accuracy checks in survey measurements. Sources and theory of errors in survey measurements. Introduction to plane rectangular coordinate systems. Basic Surveying Measurements: Linear & Angular measurements. Classical and modern methods of horizontal position establishment in surveying. Height determination by methods of spirit and reciprocal levelling. Methods of Trigonometrical, Barometric, and Hydrostatic levelling. Introduction to tacheometric surveying. Methods of obtaining field data for topographic surveys. Basic principles and uses of topographic maps. Introduction to photogrammetry.

EVE 302: Risk Assessment (2 Units C: LH 30)

Learning Outcomes:
At the end of this course, students will be able to:
1. Identify environmental hazards;
2. master risk assessment techniques and select method of approach; and
3. Apply risk assessment in the management of hazardous wastes;

Course Contents
Introduction to risk assessment, what does the law say? Fundamentals of Hazard, Exposures, and Risk Assessment. Concepts in Risk Assessment. The Risk Assessment Process (preparing to conduct risk assessments, Listing Core Activities, Prioritising Core Activities, Job Analysis, identifying hazards). Risk Assessment techniques and Methods of approach. Hazardous Waste Management Decisions from Risk Assessment. Selected Case Studies and Applications. Written safe work practices.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

EVE 401: Fundamentals of GIS & Remote Sensing (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the systematic principles of GIS and the application of GIS to biodiversity conservation and environmental studies using real-world examples;
2. acquire, combine and manipulate data from multiple sources in a GIS in order to deal and solve practical problems in biodiversity conservation and environmental science;
3. state the principles underlying the analysis of spatial data and remote sensing data and produce appropriate maps of environmental data;
4. developed practical technical skills on GIS analytical techniques; and
5. generate and critically evaluate GIS and remote sensing outcomes and write reports on GIS mapping and analysis.

Course Contents

Electromagnetic radiation and interaction with matter. Types and design of electromagnetic sensors. The photographic camera, Radiometers, thermal scanners, and multispectral scanners. Sensor platforms. Introduction to digital image processing. Image classification. Elements of photo interpretation. Definitions and Basic concepts of GIS (Geographical Information System). Spatial relationships. Elementary Mathematical concepts (graph theory, set theory, and topology). Components of a GIS. Field-based and object-based concepts of the real world. Raster and vector databases. Spatial Data Models: 2D, 3D, and 4D Model; tessellation data models; vector data models, tessellation versus spatial vector relationships: metric, topologic and spatial order. Data quality aspect: positional accuracy, attribute accuracy, logical consistency, completeness, and lineage. Data capture; data manipulation; data queries, data analysis; data modeling; data display and data presentation.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

EVE 501: Water Treatment & Supply (2 Units C: LH 30)

Learning Outcome

At the end of this course, students should be able to:

1. explain water quality and pollution control principles;
2. evaluate treatment processes;
3. design treatment plant especially low-cost options;
4. operate and manage treatment plant; and
5. develop skills in the design of water supply and distribution scheme.

Course Contents

Water quality and pollution. Water-related diseases. Basic water treatment principles. Water abstraction. Data collection in water treatment. Water pre-treatment. Coagulation & flocculation. Sedimentation. Filtration. Water disinfection. Water softening. Management of water sludges. Water distribution system – pipework, reservoirs, pumping stations, fittings & regulating devices. Procedure for main distribution network.

EVE 502: Wastewater Treatment (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the characteristics of wastewater;
2. identify water treatment processes;
3. undertake plant design with emphasis on low-cost options; and
4. explain environmental aspects and plant operation.

Course Contents

Principles of wastewater treatment (wastewater characteristics, why treat wastewater, wastewater treatment philosophy, preliminary & primary, secondary & tertiary treatment units). Reactions and reactors in wastewater treatment. Overview of biological wastewater treatment systems (activated sludge process, trickling filters, ponds, overland treatment, and constructed wetland systems). Ventilated improved pit latrines (VIPs), Septic tank and baffled septic tank systems. Wastewater stabilization ponds. Basic activated sludge and trickling filter systems of treatment. Sludge treatment and disposal.

Minimum Academic Standards

Equipment

Fluids & Hydraulics Laboratory

Laboratory testing to enhance and extend the student's understanding of the fundamental principles of fluid mechanics and hydraulics. The experiments are built around Armfield F1-10 Hydraulic Bench or its equivalent. Basic experiments linked with Hydraulic Bench are:
F1-12 Hydrostatic pressure,
F1-13 Flow over weirs,
F1-15 Bernoulli's theorem demonstration,
F1-16 Impact of a jet,
F1-17 Orifice and free jet flow,
F1-18 Energy losses in pipes,
F1-19 Flow channel,
F1-20 Osborne Reynolds' demonstration,
F1-22 Energy losses in bends and fittings,
F1-23 Free and forced vortices,
F1-25 Demonstration of Pelton turbine,
F1-27 Centrifugal pumps characteristics.
Data are collected and analysed using statistical and numerical tools. In addition, experiments in hydrology can be handled such as rainfall simulation systems.

Public Health Engineering Laboratory

These laboratory experiments are designed to enhance students' understanding of courses related to public health such as water and wastewater treatment and plant operations. Data are collected and analysed using statistical and numerical tools. Experiments will cover:
Errors of measurement; Solids' determination (total, suspended, and volatile); pH, acidity, and alkalinity; Colour and turbidity; use of Dissolved Oxygen (DO) meter; Determination of water hardness (total, calcium, and magnesium); Biochemical Oxygen Demand (BOD); Chemical Oxygen Demand (COD); Determination of Nitrate ($\mathrm{NO_3}$) and Phosphate ($\mathrm{PO_4}$); Breakpoint Chlorination; Enumeration of bacteria – Agar Plate Count, Most Probable Number (MPN) method, and Membrane Filtration (ELE Paqualab is valuable), coagulation/flocculation experiment. Key equipment should include solids determination, pH, dissolved oxygen, BOD, COD, digester, water distiller of deionizer, colorimeter, or spectrophotometer (preferred). ELE Paqualab System 50 is designed to be used for potable water testing.

Environmental Engineering Fieldwork

(a) Air Pollution Monitoring

This will involve lectures on air pollution monitoring and the use of multi-sensors air pollution monitors that can detect common air pollutants such as particulate matter ($\mathrm{PM_{2.5}}$ & $\mathrm{PM_{10}}$), Carbon monoxide (CO), Nitrogen dioxide ($\mathrm{NO_2}$), Sulphur dioxide ($\mathrm{SO_2}$), Ozone ($\mathrm{O_3}$) and Hydrocarbons.

(b) *Noise Pollution Monitoring*

This will involve the use of both Integrated and Basic Noise Level Meters all to **IEC 61672 Class 2 International Standard** in addition to a Noise Dosimeter if available. Noise measurement and analysis should include Sound attenuation with distance, Road traffic noise index, Noise Pollution Level (NPL), Loudness analysis using ISO Method A based on Stephen (1961), Noise dose, and Time Weighted Average (TWA) computation. Data to be collected and analysed using statistical and numerical tools.

Note: Fieldwork should be assigned as a course and given 1 credit unit.

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.
NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC;

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Library

In addition to the university and faculty libraries, the programme must have a departmental library that is well equipped with specialized books and journals in both physical collections and E-collections (E-Resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.
The library must also have adequate facilities for the following:

1. Reading;
2. Provisions for lending; and
3. Reservation unit for specialized materials.

Classrooms, Laboratories, Workshops, Clinics and Offices
The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Sc. Food Science and Technology

Overview

The decision to revamp the curriculum of higher education in Nigeria could not have come at a more opportune time. Employability rating of university graduates has been on a steady decline for years. In a bid to checkmate this negative trend' a fresh curriculum is hereby proposed, that will allow universities to contribute a minimum of 30% innovative content to the core of the minimum academic standard prescribed by the National Universities Commission (NUC). Hence, this new BSc. Programme. Food Science and Technology Core Curriculum and Minimum Academic Standards (CCMAS) has been prepared and approved for use in all Nigerian universities for the training of Food Science and Technology professionals. This version emanated from the collective efforts of seasoned Food Science and Technology professionals in Nigerian universities, who worked together to develop it. It is an improvement upon the B.Sc. Food Science and Technology Benchmark Minimum Academic Standards (BMAS), used over the years to the approval of the present CCMAS. The Bachelor of Science in Food Science and Technology programme will provide students with a well-balanced Food science, technology and engineering knowledge to meet the quality standard of 21st Century workforce. The need for manpower required for the preservation of many agricultural crops and for the development of products or processes that will provide nutritious and balanced diet to the people has been the concern of all involved in national development. The main objective of the programme is to provide the instructions that will train the type of food scientists and technologists capable of working effectively at the senior level in the food industry, food commodity research institutes and government or private establishments related to food. Students are expected to be exposed to the following areas:

1. evaluation of the chemical and physical properties of conventional and non-conventional sources of food;
2. use or adaptation of appropriate technology for the preservation of foods;
3. study of the nutritional and health implications of local/imported foods; and
4. provision of technical and managerial skills to industry through extension services.

Therefore, the students will be skilled to upgrade the quality of local food products, innovate new products, simulate imported food products and consequently reduce post-harvest losses and promote food security. The BSc. Food Science and Technology CCMAS contain 105 Units of core courses in Basic Sciences, General Engineering and Food Science and Technology Courses. Learning outcomes have been attached to the course content for individual courses in the CCMAS to showcase content delivery. Universities are encouraged to supply the remaining 45 units according to their peculiar needs make up a total of 150 units required for graduation.

Philosophy

The need for manpower required for the preservation of many agricultural crops and development of products or processes that will provide nutritious and balanced diet to the people has been the concern of all involved in national development. Food Science and Technology applies science and engineering principles in processing, preservation, packaging, storage and distribution, analysis and evaluation of foods and associated raw materials (additives) in exploitation, design and analysis of food systems /machineries. The general philosophy therefore is to produce graduates with high academic standard in all aspects of food and its postharvest issues possessing adequate practical background for self-employment as well as being of immediate value to industry, academia and the community in global food security.

Objectives

The objectives of the programme are to adopt the principles of Science, Technology, Engineering and Mathematics (STEM) in:

1. managing food science and technological challenges;
2. the conversion of raw agricultural produce into processed, packaged, shelf-stable food products and intermediate raw materials;
3. executing different types of food preservation;
4. establishment, maintenance and assurance of quality of food products and processes in the plant/factory;
5. design and maintenance of food process machines;
6. direct practical experience in food industries, food research laboratories/stations/higher academic institutions;
7. supporting governmental agencies responsible for the formulation and enforcement of food laws and;
8. developing and imparting entrepreneurial skills that will make graduates employable or self-reliant/self-employed;
9. understanding all the materials, components, machines, equipment, production techniques and systems in food science and technology;
10. adapting and adopting exogenous technology in order to solve local technical problems.
11. managing people, fund, materials and equipment;
12. improving on indigenous technology to enhance local problems solving capabilities; and
13. developing novel products, simulating imported food products andconsequently helping to decrease capital flight.

Unique Features of the Programme

1. Much reduced student workload;
2. Enhanced learning and application of ICT;
3. FST programme is a hybrid course that share technologies with microbiology, chemistry, chemical engineering, pharmacy, biotechnology, agricultural engineering and Nutrition;
4. Production of FST graduates that are well-equipped with all the requisite Science and Engineering tools to function optimally in the 21st Century;
5. Curriculum design focused on graduating employers of labour rather than job seekers; and
6. Training graduates with very strong leadership skills.

Employability Skills

The expected outcome of the Food Science and Technology programme, is to develop highly informed, skilled and inspired professionals that would generate novel food products, upgrade local food processing techniques, simulate imported food products and provide innovative solutions to the challenges in food industry, regulatory space and research institutes. This curriculum ensures that Graduates are adequately trained to be employed at the senior level in food industries, regulatory agencies, food service and extension organisations and research institutes. Graduates are also trained to be capable of establishing their own small and medium scale food enterprises and upgrade existing ones. In tandem with this objective, the Food Science and Technology CCMAS places a high premium on the following twelve employability skills as its desired programme outcome in line with global best academic and professional practices: Generally, the job options for a Food Science and Technology graduate are:

1. Production Manager in food companies;

2. Product/Product development Scientist;
3. Quality Assurance/Control Manager;
4. Regulatory Affairs Officer;
5. Research Officer;
6. Scientific Laboratory Technician;
7. Brewer;
8. Procurement Manager;
9. Toxicologist; and
10. Food Engineer.

21st Century Skills

The Food Science and Technology CCMAS curriculum seeks to emphasize the twelve 21st Century skills:

1. critical thinking/problem solving/decision making;
2. creativity and Innovation;
3. collaboration (teamwork and ethics);
4. communication;
5. information literacy;
6. computational thinking;
7. flexibility;
8. leadership; and
9. life long learning /metacognition.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

Title: The undergraduate programme in Food Science and Technology shall normally terminate in the award of a Bachelor of Science degree (B.Sc.) in Food Science and Technology or in Food Engineering.

Requirement for Award: To be eligible for the award of the Bachelor of Science degree (B.Sc.) in Food Science and Technology or in Food Engineering, a candidate must pass a minimum number of credit units specified by each university, but not less than 150 credit units prescribed in the NUC CCMAS. The distribution of a total of 105 units, constituting 70% of the required 150 NUC CCMAS units is as presented in Tables 1 to 7, including SIWES.

Global Course Structure

Year	**Academic Credit Units**					
	GST /ENT	**Basic Science**	**GET Courses**	**FST Courses**	**SIWES**	**Total**
1	4	16	3	2	-	25
2	4	4	16	4	3	28
3	4	-	7	16	4	27
4	-	-	-	11	8	11
5	-	-	5	9	-	14
Total: 70% CCMAS	**12**	**20**	**32**	**44**	**15***	**105**

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
FST 102	Introduction to Food Science and technology	2	C	30	-
Total		**25**			

200 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	
GET 203	Solid Modeling & Design Engineering	2	C	30	-
GET 204	Students Workshop Practice	2	C	15	45
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software	3	C	30	45

	Engineering				
HND 212	Human Biochemistry for Nutrition	2	C	30	-
MCB 201	General Microbiology	2	C	30	-
MME 202	Engineering Materials /Food Packaging materials	3	E	45	-
FST 204	Introduction to Sample and Data Handling in Food Analysis and Quality Control	2	C	30	-
FST 222	Fundamentals of Food Processing, Preservation and Packaging	2	C	30	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**25**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture and creation	2	C	15	45
GET 304	Engineering Communication and Technical Writing	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	2	C	30	-
FST 300	Laboratory Practical I (Instrumentation and chemical analyses of foods)	2	C	-	90
FST 304	Food Chemistry	2	C	30	-
FST 306	Food Analysis	2	C	30	-
FST 308	Post-Harvest Physiology and Storage Technology	2	C	30	-
FST 331	Transport Phenomena and Thermo-dynamics I	2	E	30	-
FST 332	Transport Phenomena and Thermo-dynamics II	2	E	30	-
FST 333	Food Process Engineering 1	1	C	15	-
FST 334	Food Process Engineering II	2	C	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		**23**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
FST 402	Food Plant Design and Pilot Demonstration	2	C	30	-
FST 403	Grains Technology and Storage	2	E	30	-
FST 404	Brewing Science and Technology	2	E	30	-

FST 405	Food Process Machinery	2	E	30	-
FST 415	Sensory evaluation	1	C	15	-
FST 425	Fish Processing Technology	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
Total		**3**			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I: SWEP	3	C	9 Weeks
GET 399	SIWES II	4	C	12 Weeks
GET 499	SIWES III	8	C	24 weeks
Total		**15**		

*All credited in second semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
FST 508	Food Product Development	2	C	15	45
FST 511	Food Quality Control	1	C	15	
FST 512	FST 512: Laboratory Practical II (Animal Products, Fruits & Vegetable)	2	C	-	90
FST 513	Seminar on special topic in Food Science & Technology	1	C	15	-
FST 515	Final Year Project	3	C	-	135
	Total	**14**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms,

functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria;
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;

3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;

6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;

4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton’s laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton’s laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton’s law of gravitation, Kepler’s laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

FST 102: Introduction to Food Technology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. provide a general overview of food science and technology;
2. discuss the future roles of a food technologist;
3. develop and innovate in food science and technology; and
4. explain food supply chain and factors contributing to the quality of food commodities.

Course Contents

Review of global food situation with emphasis on Nigeria. Introduction to the microflora of foods. Physical, chemical and biological principles of food processing and preservation. Engineering units and dimensions applicable to the food industry.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, others.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 203: Engineering Graphics and Solid Modeling II (3 Units C: LH 30; PH 45)

Learning Outcomes

Students should be able to:

1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. identify skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke’s and Green’s theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types; 3. numerically solve differential equations using MATLAB and other emerging applications;
3. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
4. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
5. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
6. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry

equipment, production of simple devices; electrical circuits, wiring and installation, (8-10 weeks during the long vacation following 200 level).

NOTE: **Each Programme to indicate additional details of Programme-specific activities for their students.**

MME 202: Engineering Materials: Structure and Properties (3 Units E: LH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify basic engineering materials such as metals, ceramics, polymers, and composites and describe their structures and properties;
2. state the structure-property relationships for engineering materials; and
3. describe the manufacturing processing and applications of engineering materials.

Course Contents
Basic structure of ceramics, alloys, composites, metals, and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal, and chemical properties.

FST 222: Fundamentals of Food Processing, Preservation and Packaging (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. state the principles behind food processing, post-harvest losses and preservation;
2. identify appropriate packaging technologies to increase shelf-life of products; and
3. ensure reduction and management of food wastes.

Course contents
The chemical, physical and microbiological basis of food deterioration and spoilage. A broad overview of techniques of food processing and preservation: chemical preservatives, drying, high and low temperature processing including canning and freeze-drying, fermentation and irradiation. Food waste and management. Fundamentals of food packaging. Fundamentals of extrusion technology.

HND 212: Human Biochemistry for Nutritionists (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. discuss nutrient availability, its metabolism and assimilation; and
2. investigate the effects of diet on biochemical processes.

Course Contents
Definition of terms in human nutrition. Chemistry and functions of cell constituents, biosynthesis and functions of nucleic acids. Availability of nutrients. Interrelationship of nutrients. Metabolism of nutrients under different physiological conditions. Effect of diet on biochemical process. Regulatory mechanisms for various nutrients. Inborn errors of metabolism.

MCB 201: General Microbiology **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the nature and biology of microorganisms;
2. discuss microbiological methods, instrumentation and sterilization;
3. acquire skills needed for profitable use of microorganisms; and
4. describe the factors influencing the growth and survival of microorganisms.

Course Contents

General review of the nature and biology of protozoa, fungi, algae, bacteria, archae and viruses. General characteristics, growth and reproduction of micro-organisms. Microbiology methods and instrumentation. Sterilization and disinfection. Micro-organisms in various environments – soil, water, food etc. Industrial use of micro-organisms. Pathogenic role of micro-organisms.

FST 204: Introduction to Sample and Data Handling in Food Analysis and Quality Control **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. identify and comprehend sample handling protocols;
2. discuss the compositional differences of major food groups;
3. apply analytical procedures for characterising the properties of foods and their constituents; and
4. acquire statistical skills needed for data management.

Course Contents

Preliminary handling of samples (Definition of sample, Sampling methods, Sample preparation and preservation). Variability in composition of foods. Accuracy and precision. Errors encountered in food analysis (Sampling errors and errors of determination). Sample and population. Variance. Descriptive statistics (mean, median, mode, standard deviation, standard error, coefficient of variation).

300 Level

GST 312: Peace and Conflict Resolution **(2 Units C: LH 30)**

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web

technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (3 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;

b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

FST 300: Laboratory Practical (Instrumentation and chemical analyses of foods (Grains, Oil Seed, Roots and Tubers Practical) (2 Units C: PH 90)

Learning Outcomes

At the end of this course, the students should be able to:
1. process grains, oil seeds, roots and tubers to obtain assorted food products;
2. utilise appropriate technological steps to minimise post-harvest losses;
3. develop novel food products; and
4. determine chemical composition of different food products using analytical instruments.

Course Contents

Practical and pilot scale processing of cereals, legumes and oil seeds as well as roots and tubers into flour, starch, chips, syrups, garri, noodles, etc. Demonstration of different types of yams, cassava, cocoyams and sweet potatoes, etc. Determination of the chemical composition of cereals, legumes and oil seeds. Processing of grains into flour, paste, protein concentrate, starch and popped products. Baking of bread, cake and biscuits, etc. Fried products. Oil extraction and refining. Extrusion cooking.

FST 304: Food Chemistry (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. explain the underlying the properties and reactions of various food components;
2. apply the knowledge of food chemistry to control reactions in foods;
3. identify the major chemical reactions that limit shelf-life of foods; and
4. discussion the properties and influence of water in food systems.

Course Contents

Chemistry of naturally occurring food components – proteins, carbohydrates, vitamins, minerals, fats/oils, pigments and colourings and food flavours. Their structure, chemical and physical properties and significance. Chemical, physical and biochemical changes that occur in food during handling, processing and Storage. Rancidity (Definition and types of rancidity, mechanism of formation, Effects on food quality). Introduction to sorption isotherms and hysteresis**.** Enzymic and Non-Enzymic Browning (Definitions, Mechanisms, Effects of browning on quality of foods, applications in flavor development, methods of controlling browning reactions). Pigments and Colours. Interaction of Food Components and Effects on Food Quality. Food dispersions (true solutions, suspensions, colloids, emulsions, etc.). Properties of water in food systems. Nature and significance of water in foods. States of water (solid, liquid and gas). Dispositions of water (free, immobilized and bound),.Concept of water activity. Functions of water.

FST 306: Food Analysis (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. demonstrate knowledge of protocols for analysis of foods for purposes of trade, compliance, quality assurance, authentication, complaint investigation, nutritional attributes and scientific research;

2. carry out experiments using basic laboratory instruments;
3. describe the operations of key laboratory instruments; and
4. analyse water and food samples.

Course Contents
The principles and application of analytical methods in food analysis. such as photometry, colorimetry, gravimetry, refractometry, Spectroscopy – Introduction (spectroscopy and spectrometry, Electromagnetic radiation, Electromagnetic spectrum, analyte spectrum, uses of spectroscopy). Atomic Spectroscopy, Molecular Spectroscopy, Fluorescence Spectroscopy. Polarimetry. Refractometry. Gravimetry. Electrophoresis. Centrifugation. Chromatography (Introduction, basic equipment and uses). Types of Chromatography – adsorption chromatography (liquid adsorption chromatography, liquid-liquid chromatography, Gas-liquid chromatography, Gas adsorption chromatography and Capillary gas chromatography, Reverse phase chromatography, High performance liquid chromatography). Partition Chromatography. Ion exchange (Cation and anion) chromatography. Molecular exclusion chromatography. X-ray diffraction analysis. Bomb calorimetry. NMR. Physical and chemical analysis of water and other major food components. Food colours, additives, trace metals, contaminants.

FST 308: Post-Harvest Physiology and Storage Technology (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. extend the green life and freshness of fruits and vegetables. Pre-storage processing of fruits and vegetables;
2. discuss types of storage structures and instrumentation to delay ripening;
3. maintain commodity quality and prevent deterioration and losses; and
4. integrate science and engineering practices for better preservation of foods and produce.

Course Contents
Post-harvest physiology of horticultural commodities. Tropical environment in relation to maturity, ripeness and senescence including climacteric. Physical and chemical indices and quality in fruit and vegetable crops. Control of post-harvest losses. Refrigeration and cooling systems. Handling and Storage of cereal grains and legumes. Measurement of temperature, relative humidity, moisture in stored foods. Buildings and other structures for food storage. Controlled environment for transit and long-term storage.

FST 331: Transport Phenomena and Thermodynamics I (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the concept of transport equations that describe the distribution of concentration, temperature, and velocity in time and space in food systems;
2. derive equations for specific problems and in different coordinate systems; and
3. discuss various examples illustrating the use of transport equations such as chemical and biological reactors, membrane separators, heat exchangers, cooling fins, and flows in pipes and channels.

Course Contents
Properties of fluids. Introduction to food rheology. Dimensional analysis and similitude. Fundamentals of fluid flow leading up to the Bernoulli theorem and power calculations. Fluid flow in pipes. Measurement of flow in pipes. Reynolds number and frictional

dissipation and factors. Branching in pipes. Fluid machinery with special reference to pumps and fans. Thermodynamic properties of liquid and solid foods. Equilibrium and non-equilibrium thermodynamics as applied to phase-transition dominated processes such as contact equilibrium separations.

FST 332: Transport Phenomena and Thermodynamics II (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state process operations such as evaporation, dehydration, psychometry, surface phenomena, refrigeration and freezing and explain their applications in food processing;
2. conduct heat penetration studies in canned foods;
3. carry out material and energy balance calculations;
4. derive equations for specific problems and in different coordinate systems; and
5. discuss steady and non-steady diffusion, heat and mass transfer driven processes in the food industry.

Course Contents

Evaporation, dehydration, psychometry, surface phenomena, refrigeration and freezing. Heat and mass transfer, Heat penetration within cans; factors affecting heat penetration with cans; death order of microorganisms with cans. Material and energy balance calculations, steady and unsteady conduction, free convection, forced convection and heat transfer with change of phase. Radiation heat transfer and its applications in food industry. Steady and non-steady diffusion in liquids. Mass transfer with convection and its applications in beverage industries.

FST 333: Food Process Engineering I (1 Units C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the mechanisms of, and do calculations which underpin the primary unit operations in food processing;
2. explain the importance of mechanical separation in food industry for sedimentation, centrifugation, filtration, size reduction, screening and particle size analysis;
3. appraise energy utilisation in food processing;
4. determine energy mix in food industries; and
5. state the prospects of renewable energy in food industries.

Course Contents

Mechanisms and calculations which underpin the primary unit operations in food processing. Mechanical separations (principles, design features, operations and maintenance of machineries used in food industries for sedimentation, centrifugation, filtration, size reduction, screening and particle size analysis). Emulsification; mixing; refrigeration; freezing. Concepts in energy utilization in food processing. Energy mix in food industries; prospects of renewable energy in food industries.

FST 334: Food Process Engineering II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate knowledge in various engineering properties of food and its application in food industry;

2. undertake calculations which underpin the primary unit operations in food processing; and
3. explain the terms thermo-bacteriology, thermal processing, contact equilibrium separation. membrane separations, distillation and pulsed electric field processing as relates to food science and engineering/technology.

Course Contents
Mechanisms and calculations which underpin the primary unit operations in food processing. Heat exchangers (types, features, advantages and maintenance of heat exchangers). Drying (introduction and theory, equipment design, operation, advantages and limitation of open air/sun drying, solar drying, hot air drying). Thermo-bacteriology (meaning, history, thermal death time curve, decimal reduction time.). Thermal processes. Successive sampling technique, etc. Evaporation. Contact equilibrium separation. Membrane separations and Distillation. Pulsed electric field processing.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

FST 402: Food Plant Design and Pilot Demonstration (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the construction and operating principles of food and beverage processing plants, handling and packaging systems using engineering terminologies;
2. design food processing plants, and undertake feasibility studies;
3. explain boilers, water supply and waste disposal systems;
4. discuss types, causes and preventive measures of industrial accidents; and
5. apply first aid measures to industrial accident victims.

Course contents

Plant layout and design in the food industry. Location of materials handling systems. Optimum design of food processing plants. Technical feasibility study of food processing operations. Review of the economics of process design and optimisation. Detailed process flow sheets, mass and energy balance calculations. Boilers, water supply and waste disposal systems. Group project work in a specific food process and submission of technical reports. Industrial safety (safety devices and procedures in the plant). Types, causes and preventive measures of industrial accidents. First aid measures for industrial accident victims.

FST 403: Grains and Storage Technology (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify the major grains and state their processing principles and utilisation;
2. discuss the importance of grains in daily diet;
3. describe the nutritional value of different grains;
4. state the milling processes and develop practical skills in determining the composition of grains;
5. elaborate the complete flour making process and use of cereals in different product manufacturing;
6. explain storage needs of grains, microflora and contaminants; and
7. manage stored grains.

Course Contents

Technology and chemistry of the principal grains. Conventional milling processes, use of products and by-products. Baking. Protein-enriched cereal products. Nutritional considerations. Product development. Physical properties of grains. Moisture – its significance and behavior in stored grains. Moisture Sorption Isotherms in stored grains. Changes that occur in stored grains (respiration, biochemical, functional and nutritive changes). Development of storage techniques (traditional and modern storage). Whole Grain Storage (general considerations, kinds of storage facilities – on the ground, underground, bagged, bins and silos). Structural requirements for storage bins and silos. Handling and maintenance of storage structures. Microflora in stored grains and control. Mycotoxins in stored grains and control. Insects in stored grains and control. Rodents in stored grains and control. Integrated management practices in stored grains. Design considerations of storage structures.

FST 404: Brewing Science and Technology **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the science and technology underpinning the composition and manufacturing of beer;
2. explain brewing technology and beer production;
3. acquire detailed theoretical understanding of the role of the raw ingredients of beer production on beer quality; and
4. discuss the operations of malting, mashing and hop chemistry.

Course Contents

Study of the history, production, packaging and chemistry of beer. Operations of malting, mashing, hop chemistry, boiling, pitching, fermentation, maturation, filtration and storage of beer as well as fruit composition and quality of cider.

FST 405: Food Process Machinery **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. operate food processing equipment, exploring the differentr types available;
2. describe mechanical processes involving compression, shear or impact force;
3. discuss unit operations: Description; Sorting: Operates similarly to and overlaps with grading; and
4. explain the process of cleaning and remove foreign matter and contamination.

Course Contents

Design features and functions of equipment used in the food Industry e.g. equipment for cleaning, sorting, grading, size reduction, mixing, homogenisation, filtration, distillation, centrifugation etc. Design and fabrication of simple food processing machineries. Electric motors. Automation/process control.

FST 415: Sensory Evaluation **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. account for the most common methods used for consumer-targeted sensory evaluations;
2. explain how sensory evaluation and the human sensory physiology can be used as tools in product development;
3. communicate sensory messages to consumers;
4. plan, execute and evaluate sensory methods used in product development;
5. demonstrate laboratory skills in quantitative and qualitative consumer tests; and
6. explain how sensory analysis adds knowledge about the main subject Food and Meal Science.

Course Contents

Definition. Sense organs and their physiological and psychological foundations of sensory evaluation. Sensory evaluation laboratory (design – reception and briefing room, kitchen and food preparation area, testing area, utensils and other pieces of equipment, lightening and temperature control, testing setup, testing schedule). Selection and handling of panel members (selection and training of panel, instructing the panel, etc.). Handling of samples (information on sample, quantity of sample, number of samples, coding, order of presentation, sample dilution, rinsing, etc.). Categories of sensory evaluation methods (single expert or master taster, round table method of testing, panel of judges, single stimulus). Methods of Sensory Evaluation – Discrimination or difference tests (paired comparison, Duo-trio, triangular, multiple comparison tests, etc.); Descriptive tests (ranking, scoring, profile testing, ratio scaling, etc.); Acceptance/preference tests (use of Hedonic scale and other scales). Design of experiments and choosing methods of analyzing sensory evaluation data. Factors influencing sensory measurements. The role of sensory evaluation in product quality assurance. Application of sensory evaluation to routine maintenance, shelf-life determination and reference standard for product quality. In-plant sensory evaluation procedures. Computerized sensory evaluation procedure.

FST 425: Fish Processing Technology (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define chemical composition of fish and shellfish;
2. discuss microbiology of fresh and processed fish;
3. specify methods of handling of fish;
4. explain fish canning processes, curing and freezing of fish; and
5. discuss the by- products of fish processing, microbiology of fresh and processed fish.

Course Contents
Handling of fish: spoilage of fish and shellfish; effect of temperature on fish spoilage, use of ice; Solid carbon dioxide and liquid nitrogen in fish preservations; containers for packaging and transportation of fish, handling on board fishing vessels and on shore ;use of chemical preservatives and irradiation in extending shelf-life of fish and shell fish. Canning: Principles of canning; canning materials; handling and preparation of fish and shellfish for canning; spoilage of canned fish; chemical and microbiological spoilage and their prevention. Curing: Salting of fish-principles and practices; pickling; smoked fish; spoilage of cured fish. Microbiology of fresh and processed fish: Morphology of bacteria: growth and reproduction of bacteria: effect of environmental factors like temperature, pH, oxygen, moisture, etc. Common bacteria present in fish; identification and isolation. Bacteria of sanitary significance. Chemical composition of fish and shellfish: moisture, protein, fat, carbohydrates, ash etc.

FST 427: Food Biotechnology (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. develop an understanding of the application of biotechnology in animal, plant and food production;
2. acquire practical skills in using nucleic acids sequences; and
3. recommend appropriate measures to solve technical problems using microbial strains and enzymes.

Course Contents
Scope and principles of biotechnology. Bacteria and fungi of biotechnological importance (cultivation, maintenance and storage), Strain improvement techniques (selection, mutation, recombination and gene manipulation). Plant and animal cell culture techniques. Enzymes (sources, production techniques and uses in foods).

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

FST 508: Food Product Development (2 Units C: LH 15; PH 45)

Learning outcomes

At the end of this course, the students should be able to:

1. formulate new food products;
2. manipulate food product development tools;
3. optimise food product design and development;
4. integrate cost analysis; and
5. conduct shelf-life evaluation studies.

Course Contents

Background and definition of terms (Basic and applied research, development and technical service). New products (basic concepts and ideas underlying new products development, reasons for new products, sources of pressure for new products, products life cycle). Food product development tools (expert profile panel, primary sensory panel, secondary sensory panel, research guidance panel). Types of new products for company. Stages in successful new product development. Information needed to launch a new product. Optimising food product design and development. Cost analysis. Business plan. Project. feasibility analysis; approach to setting up and running business. Case studies in New product development. Product recall (for product destruction, formulation and redevelopment). Methods of shelf-life evaluation.

FST 511: Quality Evaluation and Control (1 Unit C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain and apply properly the national and international legislation/ regulation;
2. implement food safety management systems for primary production;
3. evaluate food safety management systems and recommend the preventive measures;
4. prepare presentations relating to food safety and food quality; and
5. discuss food fortification, enrichment, labeling and risk/benefit analysis.

Course Contents

Definition. Scope and significance of food quality and quality control. Quality parameters, quality assurance and specifications. Total quality management. Food laws. Food legislation and the Codex Alimentarius. Food regulation. Food standards (International food standard and Nigerian Industrial Standards (NIS)). Good manufacturing practice (GMP). Enforcement of food standards. Principles and methods of food quality control. Quality control charts. Hazard Analysis, Critical Control, Points (HACCP) system. Plant sanitation as a quality control tool. Sensory and instrumental methods of evaluating quality parameters. Food fortification and enrichment. Nutritional labeling. Risk/benefit analysis.

FST 512: Laboratory Practical II (Animal Products, Fruits & Vegetables)
(2 Units C: PH 90)

Learning Outcomes
At the end of this course, students should be able to:
1. develop animal, fruit and vegetable products; and
2. evaluate the quality of animal, fruit and vegetable products

Course Contents
Preparation and quality evaluation of smoked fish, smoked meat, cured meat, meat sausages, salted fish, salted and dried fish, solar dried fish, etc. Processing of milk into dairy products, for example, ice cream, yoghurt, cheese, butter, etc. Evaluation of shell egg quality including external appearance (size, shape, shell colour, shell texture, shell cleanliness, etc), Candling appearance, (air cell characteristics, shell characteristics, internal quality characteristics) and opened egg quality (Haugh unit, yolk index, percentage of thick and thin albumen, etc.). Shell egg pasteurization. Processing of egg products including powdered egg products (whole egg, egg yolk, egg white, etc.), Frozen liquid egg products (whole egg, egg yolk, egg white.). Mayonnaise and salad cream production. Quality tests in milk and milk products. Milk products manufacture (market milk, ice cream, yoghurt and other fermented milk products, powdered milk products (full fat milk, non-fat milk.), butter, cheese, etc. Preparation and processing of fruit and vegetable products (fruit juices, squashes, fruit bar, jams, jellies, tomato ketchup, tomato puree, dried vegetables.). Preparation of canned and bottled fruits and vegetables spiced and fermented vegetables.

FST 513: Final Year Research Project (3 Units C: PH 135)

Learning outcomes
At the end of this course, the student should be able to:
1. identify the problem or hypothesis to research or test;
2. describe resources and constraints;
3. choose the best option from research method, product formulation, production and analyses;
4. present proposal seminars;
5. carry out researches;
6. present obtained data and conclusions in a result presentation seminar; and
7. present the final report orally and in writing.

Minimum Academic Standards

Equipment
Although other laboratories and workshops not listed here will be shared with many other departments in the faculty and the University in general, the laboratories and facilities listed in the Table below should be provided and equipped specifically for every Food Science and Technology programme.

Food Chemistry and Analysis Laboratory

S/N	Name of Equipment
1	Colorimeter
2	Balance (Research)
3	Manesty steel
4	Water Bath
5	pH Meter
6	Standing Freezer
7	Refrigerator
8	Hot Plate
9	Homogenizer
10	Refracto meter – hand
11	Laboratory benches/slabs, cupboards
12	Fume Chamber
13	pH Meter 020 JENWAY
14	Magnetic Stirrer
15	Kjehldal Distiller
16	Water bath Shaker
17	Battery operated Electronic balance
18	Top loading balance
19	Cole palmer fume hood
20	Flame photometer
21	Hot air oven
22	Kjeldahl digester
23	Markhan apparatus
24	Thermolyne bench-top muffle furnace
25	Soxhlet extraction unit
26	Magnetic stirrer
27	Analytical balance
28	Cole palmer UV/Vis spec
30	Electric table top centrifuge

Food Microbiology Laboratory

S/N	Name of Equipment
1	Kjeldahl Nitrogen apparatus
2	Soxhlet apparatus
3	Muffle furnace
4	Chromatography-Gas/Liquid
5	Digester (1007)
6	Soxtec System, Service Unit (1044)
7	Evatec System; 600 Microwave Drier
8	Cyclotec; 1093 Sample Mill
9	Markham Distiller
10	Hot Air Oven

11	Hot Air Oven (bad) size one
12	Incubator
13	Water bath (small)
14	Electric Stirrer
15	Microwave Oven
16	Hot plate
17	Balance, Top loading
18	pH Meter
19	Hot air oven
20	Microscopes
21	Cole Palmer polystat cooling/heating circulators bath (6.5 liters)

Animal Products Laboratory

S/N	Items
1	Motor driven, pickle machine
2	Hand operated pickle machine
3	Ice making machine
4	Kenwood Mincer
5	Desiccator
6	Water activity meter
7	Hauth Meter
8	Weighing balance
9	Cole Palmer fume hood

Food Processing Laboratory

S/N	Items
1	Tower pots
2	Juice extractor
3	Food mixer
4	Blender
5	Chopping boards
6	Grater
7	Scale
8	Stainless spoons (divine success)
9	Stainless forks (divine success)
10	Tin cutter
11	Rolling pins
12	Wooden sticks (spatula)
13	Perforated Stainless spoons (frying)
14	Perforated spoon
15	Flat serving plates (big)
16	Flat serving plates (small)
17	Deep soup plates (big)
18	Deep soup plates (small)
19	Cooking spoons
20	Knives
21	Flat bottom sieve
22	Sieves (with handle)

23	Stainless steel bowls
24	Plastic basin (big)
25	Plastic basin (small)
26	Plastic bowl (small)
27	Glass tumblers
28	Bread knife
29	Crown corking machine
30	Gas cooker (single burner)
31	Baking oven
32	Gas cylinders
33	Domestic gas cylinder regulator
34	Baking pans
35	Baking trays
36	Stainless trays
37	2-burner kerosene stoves (high standing)
38	Big saucer pan/pot (tower brand)
39	Medium saucer pan/pot (tower brand)
40	Cooking spoons (stainless steel)
41	Can openers
42	Cutlery forks
43	Blender (sorex brand)
44	Drinking glass/tumbler
45	Gas regulator (paca brand)
46	Hand towels
47	Ceramic plates (flat)
48	Ceramic plates (bowl)
49	13.5 kg gas cylinder (total brand)
50	Basins (stainless steel)
51	Basin plastic
52	Trays (stainless steel)
53	Buckets – plastic with cover
54	25 litre gallon black for kerosene
55	Kitchen knives with black handle
56	7 x 7 Projector screen
57	Kenwood mixer (with accessories)
58	Anerobic jar (22 x 12 mm)
59	100-liter steam jacketed kettle with tap
60	100-liter steam jacketed without tap
61	Electric Generating Plant (3.2 KVA)
62	Water bath sterilizer
63	Stuart scientific SAB vortex mixer
64	Coors porcelain mortar Z529508
65	Coors porcelain pestle
66	Magnetic stirrer X603813-IEA

Sensory Evaluation Laboratory

S/N	List of facilities
1	Product Preparation Area • A fully equipped kitchen with storage area. It should have refrigerators/freezers, conventional ranges/ovens, dishwashers • convection oven, microwave ovens, & professional grills Positive air pressure and air conditioners •

2	Sensory Testing Areas • It should have individual booths with computers for ballot presentation. The computers need to be equipped with sensory evaluation softwares like Compusense (https://compusense.com/) . SPSS and Food Processor® software installed could also be installed to the computers The booth ought to be fitted with tap water and waste water drainage wash hand/basin. Adequate lighting is to be provided within the booth.
3	Meeting room with conference table seating for 12-15 panelists, for briefing and brainstorming.
4	Objective Testing Area • Analytical balance and electronic food scales • Hydrometers, pH meter, Refractometer, Consistometer • Moisture Analyzer, Saltmeter, Specific Gravity Pycnometer

Workshops

Bakery – (Pilot Plant)

S/N	Item	Units
1	Wood fired baking oven	2
2	Electric baking oven	2
3	Dough mixer	2
4	Dough milling machine	2
5	Dough cutter/divider	1
6	Dough moulder	1
7	Baking pans	500 lbs
8	Bread slicer	1
9	Dough conditioner	5
10	Racks for bread cooling	5
11	Diesel engine	1
12	Stainless steel tables	4
13	Trolleys	3

Garri Processing Plant

S/N	Item	Units
1	Diesel powered grater	1
2	Hydraulic press	2
3	Wood fired garri fryer	1
4	Weighing balance (50 kg & 20 kg)	1 each
5	Manual Sealing machine	2
6	Industrial Sealing machine	2
7	Cassava grater (Weston Specialist Product, Ltd.)	

Malting Plant

S/N	Item	Units
1	Malting bin	1
2	Malting bin/dryer	2
3	Washing basin	1

4	Humidifier	1
5	Dryer	1

Canning Line

S/N	Item	Units
1	Electric steam boiler (Reimers Cleanbrook, Virginia. RH60)	1
2	Autoclave /Retort equipped with thermocouples	1
3	Blancher	1
4	Cooker	1
5	Can seamer	1
6	Steamer	1

Grains Processing/Milling Plant

S/N	Item	Units
1	Rice Miller and Polisher (Lewis C. Grant Ltd, Dysart, Scotland)	1
2	Attrition Grinder (Bental)	1
3	Mixer	1
4	Single or twin-screw Extruder	1
5	Hammer Mill (Horvic)	1
6	Dehuller	1
7	Drum dryer	1

Smoking Unit

S/N	Item	Units
1	Smoking kiln and Improved smoking kiln	2
2	Parboiling/scalding station	1
3	Poultry feather plucking machine	1
	Dressing table	1

Engineering Fabrication Workshop (Could be shared)
This workshop ought to be equipped with facilities for wood work, metal work and glasswork where possible.

Drawing Studio (Could be shared)
This studio will enable students to gain practical engineering drawing skills. The Studio should have adequate number of tables, chairs, drawing boards and other accessories. It will be very strategic to acquire drawing software like Alias, AutoCAD, FORMIT, etc. for digital drawing and sketching.

Staffing
Academic Staff
The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents

of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised books and journals in both **physical collections** and **E-collections (E-Resources)** of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers. The library must be connected to subscribed repository of:
1. institutions (national and international);
2. open access sources (Agora, Science direct, OARE, HINARI amongst others);
3. professional bodies' E-learning platforms; and

4. Relevant international organisations;

The library must also have adequate facilities for reading, lending and reservation of specialised materials.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Information and Communication Engineering

Overview

The Information and Communication Engineering (ICE) programme is a union of both Information Engineering and Communication Engineering, hence the name – Information and Communication Engineering. Ideally, the ICE programme should be a stand-alone department. Notwithstanding, for purposes of optimal utilisation of resources, it may be situated as a program in the Electrical and Computer Engineering (or similar) Department. The duration of the Information and Communication Engineering programme is five years of two semesters each. Graduates of the ICE programme have the choice of specialising either as Information or Communication Engineers if they so wish. The Core Curriculum and Minimum Academic Standards (CCMAS) set out here prescribes the minimum academic and facility standards to guarantee high quality graduates from this programme.

Philosoph

The training in Information and Communication Engineering is to develop graduates who are producers rather than consumers of knowledge, by being ready-made and functional engineers in industries, researchers and scholars in academia or successful entrepreneurs in Information Engineering and Communication Engineering, as well as allied disciplines. The programme seeks to develop employers of labour in the Information and Communication Engineering domain.

Objectives

The objectives of the programme are to:

1. facilitate good grasp of a broad spectrum of Information and Communication Engineering;
2. facilitate acquisition of practical work experience;
3. inculcate entrepreneurial, marketing, and management skills;
4. engage extensively in Information and Communication Engineering research and development; and
5. produce a new generation of servant Leaders in the ICE domain that are technically savvy, morally sound, and ethically grounded.

Unique Features of the Programme

1. Bringing together of two highly complementary engineering domains (Information Engineering and Communication Engineering) under one programme, with a possibility of specialisation at the final year.
2. Production of Communication Engineers well-equipped with all the requisite Information Engineering tools to function optimally in the 21st Century.
3. Curriculum design focused on graduating employers of Labour rather than job seekers.
4. Production of Engineers with strong Leadership traits.

Employability Skills

The graduates of the ICE programme will be equipped with skills to be able to:

1. apply knowledge of mathematics, science, and ICE to the solution of local engineering problems;
2. identify, formulate, research literature and analyse communication engineering problems and proffer informed solutions;

3. proffer solutions for developmental or complex engineering problems;
4. acquire and apply new knowledge as occasion demands using appropriate learning skills;
5. conduct investigation into developmental or complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to create new knowledge;
6. create, select and apply appropriate techniques, resources and modern engineering and ICT tools, including prediction, modelling and optimisation to developmental and complex engineering activities, with an understanding of the limitations;
7. apply ethical principles and commit to professional ethics;
8. analyse, design, and develop communication systems and networks;
9. analyse and design complex information engineering systems;
10. function effectively individually and as a member or leader of teams;
11. communicate effectively on developmental or complex engineering activities;
12. demonstrate knowledge of engineering, management and financial principles; and
13. engage in independent and lifelong learning.

21st Century Skills

The Information and Communication Engineering CCMAS seeks to emphasise the following 21st century skills:

1. critical thinking/problem solving/decision making;
2. creativity and innovation;
3. collaboration (teamwork and ethics);
4. communication;
5. information literacy;
6. flexibility;
7. leadership; and
8. life long Learning/metacognition.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME)

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	General Studies	Basic Science	Discipline/ GET	Programme (ICE)	SIWES Courses*	Total Units
100	4	10	3	2	-	19
200	4	-	23	3	3	30
300	4	-	18	10	4	32
400	-	-	-	9	8	9
500	-	-	5	10	-	15
Total	**12**	**10**	**49**	**34**	**(15)**	**105**

*All 15 units to be credited in the 2nd Semester of 400-Level

100 Level

Course code	Course title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	
MTH 101	Elementary Mathematics I: Algebra and Trigonometry	2	C	30	-
MTH 102	Elementary Mathematics II: Calculus	2	C	30	-
PHY 101	General Physics I: Mechanics	2	C	30	-
PHY 102	General Physics II: Behaviour of Matter	2	C	30	-

PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
ICE 101	Introduction to ICE and Applications	2	C	30	-
Total		**19**			

200 Leve

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 203	Engineering Graphics and Solid Modeling II	2	E	15	45
GET 204	Students Workshop Practice	2	C	15	45
GET 207	Applied Mechanics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
ICE 221	Electronics I: Physical and Analogue	1	E	15	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		**27**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
ICE 311	Communication Engineering Principles I	2	C	30	-
ICE 312	Signal and System	2	C	30	-
ICE 321	Communication Engineering Principles II	2	C	30	-

ICE 322	Electric Circuit Theory	2	E	30	-
ICE 324	Electronics II: Digital	2	E	30	-
*GET 399	SIWES II: Students Industrial Work Experience Scheme	4	C	12 Weeks	
Total		**28**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ICE 411	ICE Laboratory Practical I	1	C	-	45
ICE 412	Design and Installation of Electrical and ICT Services	2	E	30	-
ICE 413	Antenna and Wave Propagation	2	E	30	-
ICE 416	Data Communication Systems and Networks	2	E	30	-
ICE 417	Electromagnetic Field and Waves	2	E	30	-
*GET 499	SIWES III: Students Indistrial Work Experience Scheme	8	C	24 Weeks	
	Total	**1**	C		

***SIWES Courses**

Course Code	**Course Title**	**Units**	**Status**	**LH/PH**	
GET 299	SIWES I: SWEP	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24 weeks	
	Total	**15**			

*All credited in second semester of 400 level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
ICE 512	Research Methodology	1	C	15	-
ICE 513	Digital Signal Processing	2	C	30	-
ICE 515	Satellite Communication	2	C	30	-
ICE 519	Final Year Project I	2	C	-	90
ICE 529	Final Year Project II	3	C	-	135
	Total		**15**		

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English **(2 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional). grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton’s laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton’s laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton’s law of gravitation, Kepler’s laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero’s law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

ICE 101: Introduction to ICE and Applications (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. explain the historical perspective to information and communication systems;
2. give account of the evolution of communication systems, technologies and architecture;
3. describe the operation of analogue and digital TV systems;
4. demonstrate understanding of the various parts of a PC and other peripheral devices;
5. apply desktop editing packages and software; and
6. demonstrate hands-on knowledge of the Internet and other popular web services.

Course Contents
Basic introduction to information and communications system. Brief historical development of communications: telegraph, telephony, radio, satellite, data, optical and mobile communications, facsimile. Block diagram of a typical communication system. An elementary

account of the types of transmission for different communication systems. Introduction to Television Systems: principle of operation of analogue and digital TV systems. Evolution of mobile radio communications. A basic cellular system. GSM Architecture. Examples of mobile radio systems. Trends in cellular radio and personal communications. Nigerian Communications Act and Nigerian Communications Commission.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;

6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modelling II (2 Units E: LH 15; PH 45)
Course Learning Outcomes

Students should be able to:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. identify skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 207: Applied Mechanics (3 Units C: LH 45)

Learning Outcomes

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;

2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse.

GET 208: Strength of Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr’s circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke’s and Green’s theorem;

5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;

3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

ICE 221: Electronics I: Physical and Analogue (1 Unit E: LH 15)

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the motion of electron in different fields;
2. state the characteristics of different kinds of material vis-à-vis Energy Band Theory;
3. differentiate between Bipolar Junction, Field Effect Transistor and Thyristor;
4. design electric circuits based on acquired knowledge of Transistors and other materials;

5. explain the process of fabrication of Integrated Chips; and
6. distinguish between different types of amplifiers.

Course Contents

Free electron motion in static electric, magnetic and electromagnetic fields. Atomic theory: Bohr's model, quantum theory. Electron emission Energy-band theory of conductors, insulators and semiconductors. Semi-conductor theory Bipolar junction transistors: types, operation, characteristics, modes of connection, application. Field effect transistors: types, operation, characteristics, modes of connection, application. Thyristors; operation, characteristics, application. Introduction to semiconductor technology. Elementary discrete devices fabrication techniques and IC technology. Single stage transistor amplifiers using BJTs and FETs. Equivalent circuit and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Parameters and applications, Feedback, Broadband and narrow band amplifiers. Power amplifiers, voltage and current stabilizing circuits, voltage amplifiers, multi-stage amplifiers using BJT and FETs.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units: C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Comminication (3 Unit C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles

of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;

4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers;
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

ICE 311: Communication Engineering Principles I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the purpose of modulation;
2. describe the different types of modulations techniques, state how they differ and identify the limitations in their application;
3. discuss the broadcast bands and specifications of different modulation techniques;
4. describe, using block diagrams, the evolution of TV systems; and
5. prescribe the best modulation technique for different broadcast scenarios.

Course Contents

Modulation. Reasons for modulation. Types of modulation. Amplitude modulation systems: Comparison of AM systems, Methods of generating, and detecting AM, DBS, SSB signals. Frequency mixing and multiplying, frequency division multiplexing, applications of AM systems. Frequency modulation systems: Instantaneous frequency, frequency deviation, modulation index, Bessel coefficients, significant sideband criteria, bandwidth of a sinusoidally modulated FM signal, power of an FM signal, narrowband FM, direct and indirect FM generation, various methods of FM demodulation, discriminator, phase-lock loop; limiter, pre-emphasis and de-emphasis, stereophonic FM broadcasting. FM broadcast band specification, block diagram of FM radio receiver, limiter and ratio detector, automatic frequency control, squelch circuit, FM mono and FM stereo receivers. AM broadcast band and specification. FM broadcast band and specification. Image frequency. FM mono and FM stereo receivers. TV broadcast band and specification. Signal format, transmitter and receiver block diagrams of Black and White TV, and Color TV.

ICE 312: Signals and Systems (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and list the characteristics, properties and types of signals and systems and describe their application in various engineering disciplines;
2. describe various system properties e.g. time invariance, linearity;
3. analyse systems and signals using Fourier, Laplace and Z-transforms; and
4. identify effective control strategies towards effective sensitivity analysis.

Course Contents

System modeling. Analog signals. Convolution and correlation. Fourier and Laplace Transforms. Random processes. Sampled signals and systems. Discrete Fourier transforms. Z transforms. Analog and Digital filters. Control strategies. Open-loop, feed forward and feedback control systems. Stability, performance and sensitivity analyses. Lag and Lead compensation, Frequency domain design, PID controllers. Elements of nonlinear control.

ICE 313: Electromagnetic Fields & Waves (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the fundamentals of electrostatics and magneto-static;
2. identify the characteristics of materials and relate them to electric and magnetic fields;
3. demonstrate the theoretical background of Maxwell's equations; and
4. explain propagation characteristics, polarisation, reflection and other electromagnetic concepts.

Course Contents

Review of Vector Algebra and Calculus: Scalar product and vector product, coordinate systems, gradient, curl, divergence operations. Static electric field: Coulomb's law and Electric Field. Gauss' law and Divergence of Electric Flux Density. Work, Potential, Potential Gradient and Energy in Electrostatic Field. Current and Current Density, Conductor, Dielectrics, Boundary Conditions, Capacitance. Laplace's and Poisson's Equations. Steady-state magnetic field: Steady Magnetic Field. Biot-Savart Law. Ampere's Law. Curl of H, Stoke's Theorem. Magnetic Boundary Conditions. Magnetic Material and Boundary Conditions. Magnetic Flux Density. Vector Magnetic Potential. Inductance. Time varying fields: Faraday's Law. Displacement Current Density. Maxwell's Equations in Differential and Integral Form. Retarded Potential. Propagation: Plane Wave in Free Space. Perfect Dielectric. Lossy Dielectrics. Good Conductors. Loss Tangent and Skin Effect. Poynting Theorem. Power Density. Polarization of Plane Wave. Reflection: Reflection from perfect conductors. Refection from perfect dielectrics.

ICE 321: Communication Engineering Principles II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain fixed line telephony systems, including access, multiplexing and signalling;
2. elucidate mobile telephony systems, mobility management and network dimensioning;
3. discuss wide area packet data networks, including Internet Protocol and ATM;
4. demonstrate satellite voice communications and 3G mobile systems;
5. expatiate contemporary and emerging research areas in ICE and wide area data technologies; and
6. illustrate the interactions of commercial interests and technology standards.

Course Contents

Plain old telephone system. Cellular systems: including GSM and IS-95 CDMA. Principles of IP - datagram networks and routing. Principles of ATM;.QoS on IP; Voice over IP; GPRS and ADSL - hybrid voice/data network principles. Third generation mobile systems: WCDMA concepts, multi-user detection, antenna array techniques, MIMO, high speed packet access, long term evolution, radio resource management, packet scheduling, core network evolution. Multimedia: image and video representation and transmission. Competing technologies: WiFi, WiMAX, FttX. Emerging techniques: may include MANET, cognitive radio.

ICE 322: Electric Circuit Theory (2 Units E: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. calculate the complex power in single-phase sinusoidal and steady-state systems;
1. design a reactive load that improves a system's power factor;
2. convert wye-connected reactive loads to delta-connected reactive loads and vice versa;
3. solve for line currents and voltages, phase currents and voltages in arbitrarily interconnected balanced, three-phase circuits;
4. convert a given electrical circuit into its s-domain equivalent representation; and
5. model RLC circuits with transfer functions and solve for currents and voltages in generic RLC circuits.

Course Contents

Electric fields. Fundamental concepts. Energy storage. Magnetic fields: Fundamental laws, field calculations, and energy storage. Magnetic circuits: simple calculation of magnetic circuits, B-H curves and core losses. Inductance: Self and mutual inductance, coupled circuits. Transient and steady state response of circuits: RL, RC, RLC circuits, free and forced oscillation. Network analysis: network theorems; mesh and node analysis. Delta-Wye transformation, Superposition theorem; Reciprocity; Thevenin's and Norton's theorems; Maximum power transfer theorem. One and two-port network: driving point functions, circuit parameters, interconnection and termination, transformation. Foster-Cauer synthesis. 1 -port network-synthesis. Active filters. Approximation to nonlinear characteristics of nonlinear resistive circuits. Harmonic analysis techniques. Sensitivity analysis. Use of computer simulation packages is strongly recommended. Introduction to CAD.

ICE 324: Electronics II: Digital (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss the introductory digital concepts;
2. differentiate number systems, operations and codes;
3. classify logic gates and compute logic operations with them;
4. execute logic simplification; and
5. identify and utilise logic elements of varying complexity in realisation of digital circuits.

Course Contents

Number Systems and Code. Analysis and design of logic gates of various families: Diodes logic, RTL, TTL, ECL, MOS and MOS of digital integrated circuits. Concepts of small, medium, large, and very large-scale integration and their consequences. Introduction to analysis and design of digital systems. Boolean algebra and mapping methods: Karnaugh and variable entered Maps, combinational logic realization with gates, multiplexers, read only memories (ROMs) and programmable logic arrays (PLAs). State machine analysis and design: state diagram, state flip-flops, input and output forming Logic, State assignments, redundant states, sequential counters, and mainly synchronous systems. State machine realisation with multiplexers, ROMs and PLAs. Asynchronous systems approach to digital systems design, top-down design, trial-and-error methods. Introduction to computer structures: register, transfers, hardware programming methods, Von Neumann machines, and memory systems standard logic functions with MSI circuits: seven segment display drivers, parity generator/checker, encoders, comparators, adders.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them;
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

ICE 411: ICE Laboratory Practical I (1 Unit C: PH 45)

Learning Outcomes

1. At the end of this course, the students should be able to give practical expression to the topics learned in the various ICE courses offered during the semester/session.

Course Contents

The Laboratory Practical covers topics in some 400 level courses.

ICE 412: Design and Installation of Electrical and ICT Services (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the knowledge of health and safety at work requirement vis-à-vis installation of electrical and communication infrastructure;
2. explain the regulations relating to electricity supply;
3. design electrical installation for various environmental scenarios including domestic, commercial and industry;
4. recognise the purpose of earthing, Faraday cage, alarm emergency system;

5. illustrate NCC and FCC codes and standards; and
6. prepare Bill of Engineering Measurement.

Course Contents

Electrical Installation: Induction to Health and safety at work act in Nigeria. Electrical safety. First aid. Electricity supply regulations. Lighting and Illumination: Luminous intensity and flux. Maintenance factor. Coefficient of utilisation. Types of light sources. Calculation of lighting requirements. Glare. Stroboscopic effect. Installation materials (cables, junction box, terminations, joints). Conduits and conduiting. Truck and trucking. Electrical installation design in domestic, commercial and industrial environment. Alarm and emergency systems. Earthing and Protection. Purposes of earthing. Faraday cage. Rod electrodes. Earth electrode resistance. Earthing system. Earth fault loop impedance. ICT services: NCC and FCC codes of practice and standards. Telecommunication design and installation: Satellite, VSAT, etc. Telephone design and installation. Computer networking design and installation. Wireless LAN design and installation. Preparation of Bill of Engineering Measurement Evaluation. Contract bidding. Consultancy.

ICE 413: Antennas and Wave Propagation. (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. describe the fundamental principles of antenna radiation;
2. identify the different types of antennas used in communication;
3. define the basic parameters of an antenna;
4. illustrate the application areas of antenna in communication engineering;
5. give examples of propagation models; and
6. calculate the Link Budget and Path loss of a communication system.

Course Contents

Antenna Systems: Review of Maxwell's equations. Polarisation, polar diagrams, antenna gain, directivity, radiation resistance, impedance matching, effective length and capture area. Radiation by dynamic currents and charges, retarded potentials, the isotropic. Hertzian dipole, short and loop antenna, folded dipole antenna. Vertical and horizontal antennas, rhombic antenna, log-periodic antenna. Centre-fed linear antenna, linear arrays, radiation from diffraction gratings, Yagi-Uda arrays, integrated antennas. Microwave antenna, horn, parabolic reflectors, slot, and lenses. Field analysis of antennas. Transmitting-receiving system, reciprocity relations. Equivalent circuit of receiving antenna. Radar Systems: Principles of pulse radar and Doppler radar. Radar equation and system parameters. Components of radar systems. Study of a practical radar system. Radar signal detection. Synthetic aperture radar, tracking and scanning radar, HF (OTR) radar. Radio Wave Propagation: Electromagnetic waves, wave front, characteristic impedance of free space, reflection, refraction and diffraction. Ground waves and sky waves. The ionospheric layers, refractive index, virtual height, critical frequency and angle, maximum usable frequency, skip zone, skip distance, fading. VHF line of sight transmission. Tropospheric scattering communications. Relationship between transmitter power, antenna gains and received signal to noise in a free space radio link. VHF and microwave point-to-point link.

ICE 416: Data Communication Systems and Networks (2 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:

1. outline the basic concepts of data communications and networking;
2. describe the purpose of network layered models, OSI and the Internet Model using TCP/IP protocols;
3. illustrate noise, attenuation, and distortion and state their impact on data digital transmission;
4. demonstrate Flow and Congestion control; and
5. describe the use of network components like Bridges, Switches, and Routers.

Course Contents
Interfaces for simple computer system and terminal to terminal. MODEM, terminal interfaces, CCITT V.24/RS-232, CCITT V.28, V.35, GPIB, EIA, RS-232C standard, speed and distance limitations for V.24, RS-232C, RS-449/422/423 interfaces and standards. Channel Coding and Error Control. Digitalization: Sampling theorem, Shannon theorem, PCM and Quantization Error; Multiplexing, FDM, TDM; Higher order multiplexing. Digital Modulation Techniques. Different Modulation Schemes. Spread Spectrum Communications. Telephony. Central office switching system. Digital Switching. ISDN interfaces and functions. Frame Relay. ATM. AAL services. Traffic and congestion control. Latency/speed effect, cell delay variation. Network resource management, connection admission control, usage parameter control and priority control. Cellular Mobile Network: Cellular network architectures; Frequency management; Channel types and assignment; types of hand-off and hand-off management; Switching and transport; Wireline and microwave facilities and link design considerations. Call Processing and Signaling: Roaming and mobility management. Traffic engineering.

ICE 417: Electromagnetic Fields & Waves (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe the fundamentals of electrostatics and magneto-static;
2. identify the characteristics of materials and relate them to electric and magnetic fields;
3. demonstrate the theoretical background of Maxwell’s equations; and
4. explain propagation characteristics, polarisation, reflection and other electromagnetic concepts.

Course Contents
Review of Vector Algebra and Calculus: Scalar product and vector product, coordinate systems, gradient, curl, divergence operations. Static electric field: Coulomb’s law and Electric Field. Gauss’ law and Divergence of Electric Flux Density. Work, Potential, Potential Gradient and Energy in Electrostatic Field. Current and Current Density, Conductor, Dielectrics, Boundary Conditions, Capacitance. Laplace’s and Poisson’s Equations. Steady-state magnetic field: Steady Magnetic Field. Biot-Savart Law. Ampere’s Law. Curl of H, Stoke’s Theorem. Magnetic Boundary Conditions. Magnetic Material and Boundary Conditions. Magnetic Flux Density. Vector Magnetic Potential. Inductance. Time varying fields: Faraday’s Law. Displacement Current Density. Maxwell’s Equations in Differential and Integral Form. Retarded Potential. Propagation: Plane Wave in Free Space. Perfect Dielectric. Lossy Dielectrics. Good Conductors. Loss Tangent and Skin Effect. Poynting

Theorem. Power Density. Polarization of Plane Wave. Reflection: Reflection from perfect conductors. Refection from perfect dielectrics.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

ICE 512: Research Methodology (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:
1. define Research and state its characteristics, types and process;
2. formulate research problem and objectives;
3. construct research Questionnaire and other research tools;
4. process, by analysis, data gotten from research to extract useful information for knowledge generation;
5. distinguish between proposal in Engineering and other research proposals; and
6. cost Engineering research proposals.

Course Contents

Definition of Research. Characteristics of Research. Types of Research. The Research Process. Formulating the Research Problem. Considerations in selecting a research Problem. Reviewing Literature. Procedure for r literature review. Formulation of objectives. Preparing research design. Consideration for the Research Design. Guidelines for the construction of a research tool. Constructing a Questionnaire.Piloting the Questionnaire. Collecting Data. Ethical Issues concerning research participants. Ethical Issues relating to the researcher. Processing and analyzsng Data. Data Processing operations. Methods of data analysis. Generalisation and interpretation of results. Reporting Findings. Written research project. Report format. General attributes of research proposals. Distinguishing features of research proposal in Engineering. Components of a research proposal. Costing an Engineering research proposal.

ICE 513: Digital Signal Processing (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. illustrate the basic concepts of DSP theory such as sampling theory and discrete frequency;
2. differentiate DTFT, DFT, and FFT;
3. define the concept of filtering, time-frequency methods and identify the relations between them;
4. differentiate FIR and IIR filters, stating their frequency response and characteristics;
5. design and implement FIR and IIR filters using different methods; and

6. demonstrate successfully the design and implementation of DSP filter using MATLAB.

Course Contents
Digital Fourier transform; Fast Fourier transform; approximation problem in network theory; synthesis of low-pass filter; special transforms and their application in synthesis of high-pass and band-pass filters; digital filtering transfer function analysis; one-dimensional recursive and non-recursive filters; computer techniques in filter analysis; realization of filters in hardware and software; basic image processing concepts.

ICE 515 : Satellite Communications (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. determine the location of a satellite in space;
2. explain Kepler's laws vis-à-vis their application to the location of satellite in orbit;
3. differentiate between Earth segment and Space segment of a satellite communication system;
4. design a satellite uplink and downlink; and
5. identify the different techniques and trade-offs employed in communicating signals through a satellite.

Course Contents
Orbital equations for satellites in space. Kepler's laws of planetary motion. Space segment-based satellite subsystems including: Attitude and Orbit Control System (AOCS), Telemetry, Tracking, and Command (TTC) system, Power Subsystem, Communication Subsystem, Antenna Subsystem. System noise temperature, G/T ratio, Downlink design, Uplink design, Design for specified C/N. Design examples. Analogue and Digital modulation techniques employed in satellite communications including: FM transmission by satellite, SCPC FM links, Digital transmission, Digital Modulation/Demodulation, Digital transmission of analogue signals. Various multiple access schemes relevant to satellite communications: Frequency Division MA, Time Division MA, Code Division MA, Spread Spectrum Transmission and Reception. Very Small Aperture Terminal (VSAT) systems. Their network architectures, Access control protocols, Basic techniques, and VSAT Earth Station engineering.

ICE 516: Communications Engineering Practical (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. give practical expressions to the topics learned in the various ICE courses offered during the semester.

Course Content
The Laboratory Practical covers topics in some 500 level courses.

ICE 519: Final Year Project I (2 Units C: PH 90)
Course Content
The project work is to commence in this first phase. The preliminary sections of the project report as well as literature review are to be submitted and graded at this stage.

ICE 529: Final Year Project II **(3 Units C: PH 135)**

Course Contents

The project work is to be completed in this second phase. Each student is to submit a proper written report (banded three printed copies, and a CD-ROM of electronic copy). The project is presented and defended at a seminar. Students may choose to work on individual design projects or team design projects. These projects consist of largely industry-sponsored projects as part programming, CAD/CAM application (turning problem, surface milling, machining of curved surfaces).

Minimum Academic Standards

Equipment

Recommended List of Minimum Equipment

s/n	Description of Equipment	Remarks
Networking Laboratory		
1	D3000: Virtual Instrument Platform	Or Equivalent
2	D3000 9.0: Experimental Master PCB	
3	D3000 21.1: AM Communications PCB	
4	D3000 21.2: Superhet Receiver PCB	
5	D3000 21.4: Digital Communications PCB	
6	D3000 21.5: PAM PCB	
7	D3000 21.5: PCM PCB	
8	NTX-1 42.000: Global, Local, Wired, Wireless Networking Training Stand	
9	D-Link Switch	
10	Cisco 1 900 Router	
11	D-Link Router	
12	IEEE ComSoc Digital Library	
Transmission Line Laboratory		
1	CT1 Modicom 1: Signal sampling and reconstruction module	Or Equivalent
2	CT2 Modicom 2: Time Division Multiplexer PAM module	
3	CT3.1: PCM Transmitter System	
4	CT3.2: PCM Reciever System	
5	CT4 Modicom 4: Delta Modulation module	
6	CT5.1 and CT5.2 Modicom 5: Data conditioning and carrier modulation system	
7	CT7: Audio Input Module	
8	CT8: Audio Output Module	
9	CT20 Anacom1.1;1.2; 2: Industry Analogue Communication Module	
10	CT30: Transmission Line Trainer	
11	PS20: Power Supply	
12	FG2: Function Generator	
13	OSC1: Oscilloscope	
Fiber Optics Laboratory		
1	Modicom 6: Fiber-optic Transceiver System	Or Equi vale nt
2	NTC-1 03.000: Fiber-optic Communication Training Stand	
3	Pulse Semiconductor Laser	
4	Photodiode Current Meter	
5	Continuous Semiconductor Laser	

6	Current Generator	
7	Fast Photo Detector	
8	Stand-to-study Photo Detector Operation	
9	Optical Fiber Splicing Kit	
Microwave Laboratory		
1	CT60: Microwave Communication Trainer – Transceiver Probe	[illegible]
2	Spectrum Analyzer: 9kHz – 3GHz	
3	Indoor TV Antenna	
4	NTC-1 04: Radio Engineering and Telecommunication with MPMS	

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC;

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Library

In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised books and journals in both **physical collections** and **E-collections (E-Resources)** of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribed repository of:

1. Institutions (national and international)
2. Open access sources (Agora, Science direct, OARE, HINARI amongst others).
3. Professional Bodies' E-learning platforms.
4. Relevant international organisations.

The library must also have adequate facilities for reading, lending services and reservation of specialized materials.

Classrooms, Laboratories, Workshops, Clinics and Offices

The ICE programme shall adopt NUC recommendations for physical space requirement as presented below:

Academic	**Size (m^2)**
Head of Department's Office	18.50
Professor's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

The requirements for office accommodation are:

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD/Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Reader/ Associate Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
3.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Lecturer I	2	
5.	Lecturer II	3	

B.Eng. Industrial and Production Engineering

Overview

This curriculum is for the Bachelor of Engineering (B.Eng.) degree programme in Industrial and Production Engineering.

Industrial and production engineering is the application of the principles of mathematics, physical and social/management sciences to the design, analysis, operation, and control of man-machine work systems with maximum productivity as the primary goal. Man-machine work system includes manufacturing, mineral exploration, and exploitation, agro-allied, construction, defense as well as service industries. Thus, the programme seeks to combine knowledge of the physical laws that govern the behaviour of materials, machines, and the environment with the behaviour of people as they interact with materials, machines, and the environment in dynamic organizational operations. The programme has taken due cognisance of the emerging area of Manufacturing Systems Engineering which combines the principles of mechanical engineering, electronics, control systems, manufacturing technology, production management, and software to formulate and improve manufacturing processes. Of importance is the use of computers to control various manufacturing processes, including factory automation, design and manufacture, and awareness of the planning, control, and management methods that are relevant to modern manufacturing systems.

Primary Areas of Specialisation are:

1. ergonomics/Human Factors Engineering (designing the workplace to better accommodate, human factors - human abilities and behaviors, thereby yielding more efficient operations and fewer accidents or injuries);
2. facility Design (aimed at operational efficiency);
3. management Decision Making / Operations Research (using statistics and other forms of data analysis to aid in making management decisions);
4. manufacturing Engineering (concerned with all aspects of manufacturing operations – materials, parts, equipment, facilities, labor, finished products, delivery);
5. quality Control (using sampling, statistical analysis, and other techniques to assess and maintain the quality of products or services provided by a business or other organization);
6. work Design (defining jobs that individual workers do in performing the overall work of the organization, with the typical focus being on optimizing manufacturing operations);
7. worker Productivity (conducting time and motion studies, setting work performance standards, and proposing new/improved work methods);
8. reliability and Maintenance Engineering;
9. logistics and Supply Chain Management; and
10. operations Research.

Philosophy

The philosophy of Industrial and Production Engineering is the training of young men and women for intellectual, moral, and professional excellence as a prerequisite to living a fully human and fulfilled life in a contemporary pluralistic world in general and to the promotion of national goals of industrialisation, enterprise and self-reliance. These are needed to nudge the Nigerian economy towards a decent future especially in the face of globalisation. The philosophy, by implication, is towards producing graduates with high academic standards and adequate practical background for self-employment and for making them valuable to industries and their communities in general.

Objectives

The objectives of Industrial and Production Engineering are in line with the nation's needs for industrial development, product design and development and technological emancipation. The undergraduate training will produce graduates with sufficient academic background to meet these needs.

The objectives of the undergraduate Degree Programme are as follows:

1. to collaborate and maintain a centre of Industrial and Production engineering Studies that will be a reservoir for the state-of-the-art teaching and research facilities and at the same time to inculcate ethical standards that can meet effectively, the requirements for economic and social development responsive to, and in consonance with national goals and aspirations;
2. to produce highly innovative and resourceful industrial and production engineers who will be relevant in the industrial production as well as service sectors of the Nigerian economy;
3. to collaborate with industries to find solutions to manufacturing and operational problems;
4. to produce industrial and production engineers with strong scientific, technological, social and economic elements; and
5. to effectively and efficiently manage people, material and equipment with available fund.

Employability Skills

Industrial and Production Engineering is a very broad-based programme that covers a wide areas of employable skills. Such a spectrum includes educational institutions, research institutes, civil service, the health sector, NGOs, process industries, and any other area where manufacturing takes place or services are being provided. Other areas include:

1. systems engineering;
2. safety engineering;
3. sost and value engineering;
4. reliability and maintenance;
5. aerospace industry;
6. computer industry;
7. garment Industry;
8. pharmaceutical Industry.; and
9. petroleum Industry.

It is therefore reassuring that at the end of the programme/career, Industrial and Production Engineering graduates will have requisite professional skills that are of great values to employers.

21st Century Skills

The 21st century presents an opportunity for the Industrial and production engineer to develop breadth and depth of skills. This programme provides the skills to recogniSe the necessity and importance of the knowledge acquired and engage in:

1. creativity and innovation;
2. critical thinking/problem solving/decision making;
3. Lifelong learning;
4. Communication;
5. Collaboration (teamwoirk);

6. Information literacy; and
7. Citizenship (local and global).

Unique Features of the Programme

It is an interdisciplinary programme, which encompasses manufacturing technology, management science, optimisation of simple and complex processes, systems, or organisations. It gives a clear understanding and application of engineering procedures in manufacturing processes and production methods. IPE employs mathematical, physical, and social science, computer science, materials science, and methods of engineering design to specify, predict and evaluate the result to be obtained.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST	ENT	Basic Sciences	Discipline (GET)	Programme (IPE)	SIWES Courses	Total Units
100	4	-	14	3	2	-	23
200	2	2	-	23	-	3	30
300	2	2	-	17	7	4	26
400	-	-	-	-	14	8	13
500	-	-	-	-	13	-	13
Total	**8**	**4**	**14**	**43**	**36**	**15***	**105**

* All 15 Units of SIWES credited in the 2nd Semester of 400-Level

100 Level

Course Code	ourse Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
MTH 101	Elementary Mathematics I	2	C	45	-
MTH 102	Elementary Mathematics II	2	C	45	-
PHY 101	General Physics I	2	C	45	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	
GET 102	Engineering Graphics and Solid Modelling	2	C	15	45
IPE 102	Introduction to Industrial and Production Engineering	2	C	30	-
Total		**23**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45

GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I	3	C	9 Weeks	
Total		**27**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Artificial Intelligence and Machine Learning	3	C	45	-
IPE 301	Manufacturing Technology	2	E	30	-
IPE 311	Design of Machine Elements	2	E	15	45
IPE 317	Systems Engineering	2	E	30	-
*GET 399	SIWES II	4	C	4 Weeks	
Total		**22**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
IPE 411	Mathematical Methods in Industrial and Production Engineering	3	C	45	
IPE 421	Production and Inventory Systems Design	3	E	45	-
IPE 431	Automation and Control	3	E	30	
IPE 461	Industrial Engineering Techniques	3	E	45	-
IPE 471	Principles of Operations Research for Industrial and Production Processes	2	C	30	-
*GET 499	SIWES III	8	C	24 Weeks	
Total		**5**			

***SWEP & Student Industrial Work Experience Scheme (SIWES)**

Course Code	Course Title	Units	Status	PH
GET 299	SIWES I: SWEP	3	C	9 Weeks
GET 399	SIWES II	4	C	12 Weeks
GET 499	SIWES III	8	C	24 Weeks

Total		15		

*All credited in second semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	
GET 502	Engineering Law	2	C	30	-
IPE 522	Design and Analysis of Industrial and Production Experiments	2	C	15	45
IPE 531	Production Management I	3	C	45	-
IPE 532	Production Management II	3	C	45	-
	Total	**13**			

Course Contents and Learning Outcommes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and listthe major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;

4. analyse the concepts of trade andeconomic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the udiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs);
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
5. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
6. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

IPE 102: Introduction to Industrial and Production Engineering (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the classification of industrial and production engineering into its vital thematic components.
2. specify, predict and evaluate the results obtained from a system or processes that are in place or being developed, by interpreting designs;
3. articulate the principles of industrial and production engineering; and
4. relate the essence or target of industrial and production engineering to completing a production process.

Course Contents
Classification of modern industry. Industrial and production activities. Productivity and its effects on economic development and the standard of living of the citizens of a nation. Work design and Measurement: control, operation and design of manned industrial and service systems. Methods and techniques of measuring work performance. Safety engineering. Principles and procedures of systems design and operation systems that involve people for maximal safety. Job satisfaction and efficiency. Principles of motion economy and Plant location. Material handling principles. Selective treatment of other basic techniques actually used by industrial and production engineers.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules

of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course content
Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents
Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis,

sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;

6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors rank;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:\
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity.

Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services;
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student’s major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;

7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports.

Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy System and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web

technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

IPE 301: Manufacturing Technology (3 Units E: LH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify the types and organisation of engineering Workshops;
2. list the types of manufacturing processes and state their uses;
3. describe the common machines and tools used in manufacturing process;
4. explain the operations and capabilities of machines used in manufacturing;
5. recognise engineering materials, their types, uses and properties;
6. recognise safety rules and regulations in the workshop and state their obligations in ensuring safety;
7. explain parts of Lathe accessories and attachments, drilling machines, drill bits and their uses;
8. identify and describe simple metal cutting applied to hand tool and single point tool geometry; amd
9. identify cutting fluid and state the general principles of working metal cutting machine tools.

Course Contents

Elementary introduction to types and organization of engineering workshops covering jobbing, batch, mass production. Engineering materials: Their uses and properties. Safety in workshops and general principles of working. Bench work and fitting: Hand tools, instruments. Carpentry: Hand tools. Materials. types of joint. processing of timber. Blacksmithing, and tools and working principles. Joints and fastenings: threaded fasteners. riveting, welding, brazing, and soldering. Measurement and marking out for uniformity. circularity, concentricity, etc. Standard measuring tools used in the workshop.
Simple metal cutting applied to hand tools. Single point tool geometry. Cutting fluid General principles of working of standard metal cutting machine tools. Work and tool movement, speed and feed range. Centre lathe operations: Straight/taper turning. Thread cutting. Parts of lathes accessories and attachments used on centre lathe. Drilling machine, drill bits and uses.

IPE 311: Design of Machine Elements (2 Units E: LH 15 PH 45)

Learning Outcome

At the end of this course, the students should be able to:

1. state the fundamentals of machine design;
2. identify machine parts/elements, state their functions and describe their failure modes;
3. recognise the strategies of safety and its significance and application in design;
4. state the environment in which machine parts are required to function.
5. design machine elements using industrial codes and standard from handbooks and other sources;
6. identify the material constituents of machine parts, their engineering properties and make appropriate selection based on design requirement(s); and
7. design some machine parts based on the knowledge gained.

Course Contents

Principles and methods of design. Strength calculations. Standards. Preferred numbers and fits. Materials, standard sections and dimensions. Failure and factors of safety. Machine Elements: Design of the following: Riveted joints. Welded joints. Threaded joints. Springs. Friction drives. Belt and rope drives. Chain drives. Power screws. Brakes. Couplings and clutches. Machine Frame. Keys. Cotters and spine joints. Design and reduction of gears, Use of handbooks and standards, Choice of Manufacturing Processes on design of machine elements, assembly and performance.

IPE 317: Systems Engineering (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and describe the fundamental concepts of systems engineering, best practices and emerging trends;
2. implement the process or stages of system engineering from problem identification to implementation and follow-up;
3. synthesise a system and analyse it;
4. Articulate the structure of a system and its design; and
5. recognise the input and output requirements of a system, the knowledge of the technology involved, the performance requirement, the cost implications during implementation and follow-up.

Course Contents

Systems engineering – definition. The process: problem identification. problem definition. Modeling. Solution testing. Implementation. Follow-up. Systems synthesis and analysis: System structure. System design. System requirement: Input / Output requirement. Technology requirement. Cost requirement. Performance requirement.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

IPE 411 Some Mathematical Methods in Industrial and Production Engineering (3 Units C: LH 45)

Learning Outcomes

At the end, the student should be able to:

1. solve higher order linear and non-linear differential equations and apply them to modelling and design of systems.
2. state Lagragian functions and discuss its importance and application in engineering optimisation problem solving.
3. apply Laplace and Fourier transforms techniques to solve differential equations in industrial and production systems.
4. apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data and probability theory in testing and quality control.

Course Contents

Integral Transforms: Laplace and Fourier transforms. Application to boundary value problems in Engineering Calculus of Variations: Langrange's equation and applications to Industrial and Production Engineering Scenarios Probability: Probability laws, Conditional Probability and dependence of events. Discrete and continuous Probability distribution. Probability functions: Density function and Distribution Function. Expected Values, Moments. Standard Distributions involving Binomial, Poisson and Normal Distributions. Statistics: Regression and Correlation: Method of least squares, Linear and Introductory Non- Linear regressions, Total and Partial Correlation. Sampling theory: Sampling distribution of mean. Confidence Interval for mean and Proportion. Test of Hypotheses: Development of Null and Alternate Hypotheses. Decision making with Hypothesis. Types I and II errors. Industrial Application of statistics and probability theories.

IPE 421: Production and Inventory Design (3 Units E: LH 45)

Learning Outcome

At the end of this course, the students should be able to:

1. recognise the strategic role of the supply chain and the key parameters of performance by identifying Facilities, Inventory, Transportation, Sourcing, Information and Pricing;
2. identify analytical decision support tools (both models and applications) as well as the organizational models that successfully allow companies to develop;
3. analyse and develop simple inventory management policies under deterministic environments;
4. develop aggregate production plans and detailed schedules through simple policies; and
5. recognise the dynamic interactions among different elements of a supply chain system.

Course Contents
Simple Inventory control Methods with deterministic and stochastic demand. The EOQ Model. lot sizing. supply chain management. Scheduling. Materials Requirement Planning (MRP). Just-in-Time models. Pull Control Systems and Aggregate Planning.

IPE 431: Automation and Control (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the fundamental definition and concepts of automation and Control engineering;
2. explain control system in production engineering systems such as CNC machine tools, Production-Inventory systems;
3. identify signal flow graphs and interpret them;
4. explain and classify transfer functions into various types and interpret them;
5. state the uses of block diagrams and the mathematical basis for the design of control systems; and
6. discuss the importance and application of good instrumentation for the efficient design of process control loops for production systems.

Course Contents
Basic definitions and concepts. Control systems in Production Engineering, e.g. CNC machine tools, Production–Inventory Control, etc. Block diagrams and their reduction. Signal flow graphs. Transfer functions. State–space representations. Some common transfer functions. System Stability: Routh, Hurwitz, etc. stability criteria. System Classification. Error constants and sensitivity. Types of system inputs. Second – Order Systems. Transient and Steady–State Responses. Performance Indices. Root–Locus Analysis. Root–Locus Design. Bode Analysis. Bode Design. Nyquist Analysis. Nyquist Design. Nicholas Chart Analysis. Nicholas Chart Design.

IPE 461: Industrial and Production Engineering Techniques (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the meaning and essence of break-even analysis and its application in choice decision making in the presence of alternatives;
2. identify and explain the types of production system.
3. enumerate the different manufacturing techniques that are available;
4. state the meaning of facility Layouts and classify them;
5. state the uses of algorithms for designing process and layout designs;
6. comment on transportation problems as optimisation problems and their essence in the industry;
7. explain how to identify transportations problems, develop strategies to solve them and to utilise available techniques to solve them;
8. state the principles of time and motion studies and describe their essence in workplace design;
9. discuss the applications of the learning curve principles in real-life; and
10. explain the essence of plant location analysis in decision making.

Course Contents
Break- Even Analysis and its application in decision making. Types of production systems and manufacturing techniques. Facility Layout types. Process layout and Product Layout design. Transportation Techniques Work System Design. Learning Curve. Plant Location Analysis. Other Industrial and Production engineering techniques.

IPE 471: Principles of Operations Research for Industrial and Production Processes (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the fundamental principles of OR and how to develop OR techniques and tools;
2. develop linear programming and simplex models for industrial and Production systems;
3. apply these techniques and algorithms to solve them;
4. interprete and apply results of an OR model; and
5. disseminate the results of OR project through a written report and oral presentation.

Course Contents
Development of O.R. techniques and tools. Deterministic models and their place in industrial operations. Scope, theory and application of linear programming models. Simplex method. Resource allocation, assignment and transportation problems. Duality. Review of computer programming with special reference to Industrial and production problems. Application of software such as Solver, TORA etc to solve O.R. problems. OR project with written report and an oral presentation

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs);

methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions.;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

IPE 522: Design and Analysis of Industrial and Production Experiments (2 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain how to design experiments, carry them out, and analyse the data yielded;
2. state process involved in designing an experiment including factorial and fractional factorial designs;
3. State how a factorial design allows cost reduction, increases efficiency of experimentation and reveals the essential nature of a process;
4. evaluate the logic of hypothesis testing, including analysis of variance and the detailed analysis of experimental data;
5. formulate understanding of the subject using real examples, including experimentation in industrial and production engineering;
6. introduce Taguchi methods and compare and contrast them with more traditional techniques; and
7. discuss the roles of response surface methodology and its basic concepts.

8. describe how the analysis of experimental design data is carried out using the most common software packages.

Course Contents

Examples of experimental design problems in production planning and manufacturing. Basic principles of experimentation. Randomization. Replication and local control. Blocks and Latin square designs. Two level factorial design. Analysis of experimental data. Special problems of current interest. Applications in industrial and Production engineering. Confounding in a 2^k experiment. Introduction to fractional replication. Introduction to response surface methodology. Introduction of Taguchi Method and its comparison other techniques

IPE 531: Production Management I (3 Units C: LH 45)

Learning outcomes

At the end of this course, the students should be able to:

1. state the types and principles of production processes;
2. apply basic materials management concepts;
3. develop group technology and cellular;
4. Explain the concepts of purchasing and implementation;
5. select appropriate interest rates and describe the methods of analysis;
6. discuss manufacturing methods in a range of industries;
7. visit manufacturing industries;
8. write a comprehensive report and communicate engineering knowledge gained during the visits; and
9. state the fundamentals of small-scale businesses and their industrial engineering roles.

Course Contents

Principles of production. Types of production processes. Development of Group technology and cellular systems. Materials management. Purchasing methods. Engineering Economy. Economic analysis of engineering projects. Selection of appropriate interest rates and methods of analysis, depreciation and tax considerations. Survey of manufacturing methods in a range of industries, textiles, timber, food, agriculture, etc. Plant visits. Overview of Some manufacturing industries such as cement, electronics, etc. Industrial computers and their applications. Small–scale businesses in Industrial and Production Engineering.

IPE 532 : Production Management II (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the fundamental principles of production planning and control and indicate how the knowledge of budgeting and cost control influences their outcome;
2. explain the meaning of forecasting, identify its types and show its importance;
3. determine forecast accuracy and interpret the result;
4. explain the principles of quality control and identify problems in quality improvement process;
5. explain and apply statistics and probability to quality control and management;
6. describe the basic concept of Total Quality management, the steps involved and its implementation;

7. perform process capability and specification studies;
8. explain the basic principles of reliability;
9. apply the principles of statistics and probability in characterising the reliability of an item or system;
10. explain the bathtub curve and its application;
11. determine the reliability of series and parallel systems;
12. explain basic concepts such as preventive ; and
13. corrective maintenance, maintainability and availability.

Course Contents

Production Planning and Control. Principles of control, Budgetary and cost control. Information Processing and Control. Forecasts. Principles of forecasting. Simple forecasting models and forecast accuracy. Schedulling Techniques. Sequencing n-jobs through n-machines. Quality Control. Quality Control Principles, Total Quality Concepts, economics of quality. process capability. Control Charts. Sampling systems. Inspection Systems. Quality Motivation and Training. Basic concepts of Reliability Engineering. Principles of reliability engineering, The Bathtub Curve. Failure rate analysis. Reliability of systems – Series and Parallel Systems, Maintenance – Preventive and Corrective. Maintainability and Availability.

Minimum Academic Standards

Equipment

The required equipment and tools required for the Industrial and {Production engineering programme in accordance with the requirements of major laboratories are listed below. Note that accessories and consumables needed for effective use of these equipment are not listed but will be requested by the department that runs this curriculum when purchasing the equipment.

Industrial and Production Engineering Laboratory Equipment

1. Induction Furnaces.
2. CNC machines
3.Lathe Machines.
4.Drilling Machines.
5.Hacksaw, Stolling, Cutting Machine.
6.Universal Gear Hobing Machine.
7.Sheet streaming, Bending, Rolling Machine.
8.Work Press Machines such as Eccentric press, punch press, Arbor press, Double Piller Type.
9.Screw presses.
10.Hammer mills.
11.Modern callipers and gauges.
12.Computer Workstations and Software.
13.Ergonomic Lab Workstations.

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC;
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised and modern books and journals in both **physical** and **E-collections (E-Resources)** of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.
The library must be connected to subscribed repository of:
1. Institutions (national and international);
2. Open access sources;
3. Professional Bodies' E-learning platforms; and
4. Relevant international organizations;

The library must also have adequate facilities for reading, lending services and reservation for specialised materials. It must have a dequate seating capacity for users up to 2,700.

Other requirements include shelves (Main/Engineering Branch Library) , trolleys, reading chairs/tables. Computers, Printers, Scanners, Labelling machine, Catalogue cabinets, Kirk stand, cataloguing and classification tools, giant size staplers, cutter tables, library of congress subject heading, delivery decimal classification scheme, Universal decimal classification scheme.

Classrooms, Laboratory, Workshops, Clinics and Offices

The ICE programme shall adopt NUC recommendations for physical space requirement as presented below:

Academic	**Size (m^2)**
Head of Department's Office	18.50
Professor's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

The requirements for office accommodation are:

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD/Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Reader/ Associate Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
3.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Lecturer I	2	
5.	Lecturer II	3	

B.Eng. Marine Engineering

Overview

Marine Engineering is the art of applying scientific principles to the design, analysis, modelling, simulation, production, monitoring, operation, diagnosis, maintenance and management of engineering systems and equipment, which work in marine environment, such as ships, and the variety of offshore structures. It introduces them to the techniques and tools of research; develops in them the spirit of enquiry and generally prepares them to face challenges and solve problems in the field of Marine Engineering and related disciplines.

The three (3) main specialisations under the programme are:

Marine Power plants Option

Marine Power Plants Option deals with design, running and maintenance of all onboard machineries, generators, propulsion engines, electrical systems, electronics, navigational and control mechanisms. The graduates of this option, generally called the Marine Engineers, take complete charge of the engine room of a ship and the functioning of various devices like electric motors, steam engines, propulsive engines, etc. They also develop newer designs for the engines of sailing vessels and check the efficiency of existing equipment like gas or steam turbines, diesel or nuclear propulsion plants. New technologies like superconductivity, fuel cells and hydrodynamics are being explored in this field to make the vessels more efficient: thus, providing this field with even more interesting job propositions.

Naval Architecture and Ship Building Option

Naval Architecture presents abundant possibilities of combining suitable ship theory with sound technical skills in the design, construction, optimisation and commissioning of marine vessels and structures. The naval architects are responsible for the management, inspection, analysis and repair of all floating and fixed marine structures. Note: Naval architects apply advanced knowledge and skills of mathematics, ship hydromechanics, properties of materials, structures and ship concepts to design/ develop novel marine vehicles having good socioeconomic and environmental impacts.

Offshore/ Subsea Engineering

Offshore engineering is a multidisciplinary specialization that involves the design, installation, operation, maintenance and decommissioning of all fixed and floating offshore structures. Whereas, Subsea Engineering deals with the analysis, design, development and maintenance of subsea field, flowlines and risers and related systems. This specialization is very important for the development of offshore oil/gas, harnessing of renewable offshore energy and safe marine operations/ service in deep sea.

Philosophy

The undergraduate programmes in Marine Engineering are designed to apply the basic principles of the physical sciences, fluid mechanics, thermodynamics, corrosion, electrical technology, oceanography, robotics, geotechnics, structures, marine hydrodynamics as well as sound computational techniques for the safe and efficient design, construction, maintenance and expert management of marine systems.

Objectives

The aim of the programmes is to impart state-of-the-art theoretical knowledge and practical skills to students for cutting-edge research, innovative design, and the development of safe, efficient and reliable maritime systems, processes, equipment and structures. The objectives of the programmes in the Department of Marine Engineering are to:

1. impart students with the principles of Marine Engineering, Naval Architecture, Offshore and Subsea Engineering that would reflect the requirements of ship and boat building firms; oil/ gas industries, security operatives and governmental agencies;
2. train students to prepare and read technical drawing of engineering designs, manufacturing and assembling of engineering structures and systems;
3. train students to run, maintain, and repair ship power plants, instrumentation and onboard equipment necessary for the propulsion and safety of the ship's hull, and for the care, comfort and safety of passengers and crew;
4. equip them with tools and skills required to design reliable, efficient, and economically viable marine power plants and their control systems;
5. help students with skills solve complex engineering problems related to shipbuilding, offshore and subsea systems using Computer-Aided Engineering software (such as CAE, CAD, CAM), mathematical analysis and empirical procedures;
6. develop students in critical reasoning, good professional judgment, and the ability to take responsibility when undertaking important tasks.
7. make them to be proficient in maritime operations so as to carry out ship's hull and equipment, offshore and subsea systems survey for classification societies and consultancy work;
8. furnish students with the state-of-the-art technologies for the optimal implementation of soft and hardware;
9. teach entrepreneurial skills that can facilitate human capacity building, for sustainable socioeconomic development; and
10. make professionals to be adequately trained to improve on indigenous technology with a view to enhancing local problem solving and resource optimization.

Marine Power plants Option
In addition, this option develops knowledge, skills and tools to aid the:
1. design, optimisation and analysis of ships and offshore energy systems;
2. modelling, simulation and successful implementation of onboard integrated systems;
3. selection of appropriate power generators, auxiliary systems and mechatronics;
4. monitoring, faults diagnosis and repair of all onboard ship equipment; and
5. design, running and maintenance of diesel engines/ gas turbine systems and auxiliaries

Naval Architecture and Ship Building
In addition to the general features, Naval Architecture presents abundant possibilities to combine suitable ship theory with technical skills in performing detailed:
1. design, construction and commissioning of marine vessels and structures;
2. management, inspection, analysis and repair of floating and fixed marine structures;
3. design analysis for vessels conversion, rebuilding, modernisation or repair; and
4. research and development of advanced, non-conventional marine vehicles/ structures

Offshore/ Subsea Engineering
Supplemental to the general characteristics, Offshore/ Subsea Engineering equips students with relevant theoretical knowledge and practical skills to enable them:
1. understand the basic principles underlying the operation of offshore and subsea systems and operations;
2. design, model, simulate and optimise offshore systems under varied environmental conditions;

3. understand safety measures, perform risk analysis, and pollution control in the environment of the operating system;
4. perform structural integrity analysis of fixed and floating offshore platforms, subsea pipelines, flow lines, risers and other underwater equipment;
5. characterise metocean data in relation to structural dynamics; and
6. calculate the stability and draught of offshore vessels for safe marine operations.

Employability Skills Emphasized

At the end of their training, graduates of the programmes in Marine Engineering may find employment opportunities in the following areas:

1. Oil and Gas producing/Marine Service Companies.
2. Engineering design, System modelling and Manufacturing establishments.
3. Government Ministries, Departments, Agencies, and Parastatals.
4. Research and Development (R&D) firms.
5. Educational Institutions.
6. Ship and boat building yards.
7. Entrepreneurship.
8. Shipping and Fishing industries.
9. Marine survey and Certification firms.
10. The Navy.
11. Engineering consultancy.
12. Environmental consultancy.

In tandem with global best academic and professional practices, the programmes are structured to equip the graduate engineers with competences and employability skills to demonstrate:

Sound Engineering knowledge: Ability to apply principles of Mathematics, physical sciences and engineering to the investigation, analysis and interpretation of complex engineering problems as to arrive at substantiated expert solutions,
Good Analytical *Skill*: Ability to identify, formulate, research and analyse developmental and extant complex engineering problems to reach cost-effective conclusions by applying sound engineering principles and mathematics
Good Experimentation *Skill*: Ability to carry out detailed investigation into difficult problems using design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
Expert Usage of Modern R&D Tools: Being able to use modern software to investigate, analyse, synthesize, simulate and characterise engineering systems and processes in both design and off-design conditions. A great engineer needs to be able to comprehend complex systems, how they work, how problems arise and how to fix them.
Usage of Modern Tools: Expertise to evolve and implement appropriate software for computer-aided design, analysis, modelling, manufacturing, simulation, and optimisation of novel engineering equipment, and improved performance of existing systems and processes.
Creativity and Innovativeness: Ability to think outside of the box and device ways and means to improve existing systems and invent new ones, using both manual and software techniques. It is knack to evolve solutions to difficult engineering problems, and design systems or processes that provide utility.
Technical Communication Skills: Communicate effectively in written and oral English, and do effective presentation with explicit engineering drawings of complex engineering systems/ activities to colleagues, management and clients; in addition to giving and receiving clear instructions.

Good Entrepreneurial/ Managerial Skills: Ability to exercise business ingenuity and managerial acumen imbued with excellent financial prudence and engineering precision in decision making and projects execution in both private firm andin a multidisciplinary environment.
Good Team Player: Ability to function effectively as an individual, and as a member or a leader of a team of multifaceted and /or multidisciplinary setting. A great engineer needs to work harmoniously, encourage, empower, complement and improve team members.

21st Century Skills

A study reports that about 30% of the activities in 60% of all occupations could be automated. This means that many workers will find themselves working alongside rapidly evolving robotics, pushing human counterparts to keep pace. Hence in addition to the sound theoretical concept, the knowledge of artificial intelligence, allocation of more time for Practical and the use of modern training software and simulators in core courses are emphasized in the course contents.
Learning Skills: The five Cs of curiosity, critical thinking/problem solving/decision making, creativity and innovation, collaboration (teamwork) and communication skills. These prepare the student's mind to easily adapt to and maximize usage of resources within contemporary work environment.
Investigative Skills: Information gathering; Objective analysis; Attention to details; Contrast between abstract and concrete facts; Sensitivity to uncertainties; Good validation procedures; and Technology literacy to enable the students to confidently decipher fact in the sea of information with minimal fear, errors and doubts (FED), as well as guarantee the credibility of the source of information.
Life Skills: Self-discipline; moral rectitude; honesty & trustworthiness; proactiveness; self-motivation; leadership charisma; managerial acumen; being dynamic & resilient; productivity and good interpersonal skills are intangible but very crucial in preparing the student for a successful personal as well as professional life after graduation.

Unique Features of The Programmes

In addition to the sound theoretical concept, the knowledge of artificial intelligence and allocation of more time for laboratory, the following changes make the CCMAS different from the old BMAS:
The inclusion of the three basic options in Marine Engineering: (a) Power Plants Option; (b) Naval Architecture and Ship Building; and (c) Offshore/ Subsea Engineering. This categorisation is necessary to prepare them for specialised fields in the industry and at PG level. The old curriculum was broad but lacked depth.

1. At 200-Level, a new course, "Marine Business and Environment," is introduced to give students an overview of the maritime industry, businesses, career prospects, HSE requirements and their regulators. Also, Naval Architecture 1, and Navigation and Meteorology are moved down to 200-Level as common courses for all options. Computing and Software Engineering, and SIWES 1 are considered as university-based Electives.
2. At 300-Level, a new course, "Cargo Handling and Marine Operation," is introduced to equip students with the various techniques of cargo loading, unloading and preservation; in addition to the different marine operations and their regulations. Three courses: (a) Marine Diesel Engines 1; (b) Ship Engines and Powerplants 1; and (c) Marine Steam and Gas Turbines are now introduced as common courses for all options at 300-Level. However, Engineering Statistics and Data Analytics, SIWES II are considered as university-based optional courses.
3. At 400-Level for Power Plants Option, Mechanical Design II is replaced with Marine Engineering Design in order to reflect the design of marine systems. Ship Propulsion is

expanded to include ship resistance. Therefore, it is now "Ship Resistance and Propulsion." A new course, "Computer Aided Design (CAD) in Marine Engineering and Naval Architecture," is introduced for hands-on computer-based design, analysis and simulation of marine structures and systems. Welding and Fabrication is optional.

4. At 500-Level, two new courses: "Ship Vibration and Rotor-dynamics; and Risk and Reliability Engineering," are introduced to enable students measure, interpret and attenuate undesirable vibrations, and to ensure system reliability and low-risk operations. Optional courses suggested are: (a) Marine Boilers and Burners; (b) Ship Energy Management Systems; and (c) Marine Surveying and HSE.
5. Software for CAD and marine structural analysis and simulation are included, and time allocated on the course structure to teach them alongside practice sessions.
6. Inclusion of virtual laboratory where students can perform virtual experiment of real and conceptual systems to predict their behaviours in design and off-design conditions. Stimulated parametric study can be carried out and animation videos (on different powerplants, dynamics of offshore structures, hydrodynamics of ships, cavitation of propeller.) can be used for academic demonstrations.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.

5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higherlevel. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**General Studies (GST/ENT)**	**Basic Sciences**	**Discipline (GET)**	**Programme (MAR)**	**SIWES Courses**	**Total Units**
100	4	16	3	2	-	25
200	4	-	23	3	3	33
300	4	-	7	10	4	25
400	-	-	-	0	8	8
500	-	-	5	09	-	14
Total	**12**	**16**	**39**	38	**15 ***	**105**

*All 15 units of SIWES credited in the 2nd Semester of 400-Level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics 1& II	2	C	-	90
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
MAR 124	Introduction to Marine Engineering	2	C	30	

	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, logic, and Human Existamce	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
MAR 201	Navigation and Meteorology	2	C	30	-
MAR 203	Introduction to Naval Architecture ans Offshore Engineering	3	E	30	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**29**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
MAR 311	Marine Diesel Engines I	3	C	30	45
MAR 314	Marine Steam and Gas Turbines	3	C	45	-
MAR 323	Naval Architecture I	2	E	30	-
MAR 352	Marine Electrical Tech & Instrumentation	3	E	30	45
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**19**			

***SIWES Courses**

GET 299	SIWES I: SIWEP	3	C	8 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15***		

*All SIWES Experiential Courses of 15 units credited for 2nd Semester of 400-Level.

Marine Power Plants Option
400 Level

Course Code	Course Title	Units	Status	LH	PH
MAR 421	Ship Resistance and Propulsion	3	E	45	-
MAR 431	Marine Auxiliary Machinery	2	E	45	-
MAR 433	Ship Engines and Power Plants II	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MAR 516	Refrigeration and Air-conditioning	3	C	45	-
MAR 521	Ship Design and Construction	3	C	45	-
MAR 531	Marine Diesel Engines II	3	C	45	-
MAR 532	Running and Maintenance of Ship Power Plants	2	E	30	
	Total	**14**			

Naval Architecture and Ship Building Option
400 Level

Course Code	Course Title	Units	Status	LH	PH
MAR 417	Computer Aided Design (CAD) in Marine Engineering and Naval Architecture	2	E	15	45
MAR 421	Ship Resistance and Propulsion	3	E	45	-

MAR 423	Ship Structures and Strength	3	E	45	-
	Total	**8**			

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MAR 515	Ship Vibration and Rotor Dynamics	3	C	45	-
MAR 521	Ship Design and Construction	3	C	45	-
MAR 523	Naval Architecture II	3	C	45	-
MAR 525	Shipyard Technology	2	C	15	45
	Total	**16**			

Offshore and Subsea Engineering

400 Level

Course Code	Course Title	Units	Status	LH	PH
MAR 423	Ship Structures and Strength	3	C	45	
MAR 431	Offshore Systems Design and Analysis	2	C	30	
MAR 465	Offshore and Coastal Engineering	3	C	45	
	Total	**8**			

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MAR 561	Basic Drilling Engineering	2	E	30	
MAR 563	Subsea and Pipeline Engineering	3	-	45	-
MAR 564	Ship and Offshore Hydrodynamics	3	-	45	-
MAR 565	Mooring, Risers and Drilling Systems	3	-	45	-
	Total	**16**			

Course Contents and Learning Outcomes

100 level

GST 111: Communication in English **(2 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;

1. identify and list the major linguistic groups in Nigeria;
2. explain the gradual evolution of Nigeria as a political entity;
3. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
4. enumerate the challenges of the Nigerian state regarding nation building;
5. analyse the role of the judiciary in upholding fundamental human rights
6. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
7. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3d objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;

8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)
(2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule)

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;

6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MAR 124: Introduction to Marine Engineering (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. appreciate the duties and career prospects of a marine engineer;
2. identify the various types of ship powerplants, auxiliaries and their functions;
3. explain marine engineering terms and engine room layout; and
4. classify and state the uses of harbour facilities and operations.

Course Contents
The basic fields and career prospects in Marine Technology. Introduction to marine vessels, equipment and facilities for transportation, offshore and harbour operations. Definition of terminologies. Marine engineering systems and machinery onboard ships. Types of ship power plants, prime movers and auxiliary machinery onboard. Machinery arrangements and their functionalities. Field trip to Marine industry/production facilities.

200 level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;

3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, others.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T

behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and

7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and

4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

MAR 201: Navigation and Meteorology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. demonstrate good seamanship skills, ropework and boat rigging;
2. identify and describe Marine Communications Systems and Global Maritime Distress and Safety Systems (GMDSS).;
3. perform First-Aid Treatment, rescue operation and personal survival;
4. describe the procedure for launching and retrieving lifeboats;
5. describe bridge equipment, navigational aids, and onboard machineries; and
6. perform weather prediction and describe basic meteorological equipment.

Course Contents

Introduction to seamanship skills. Ship nomenclature. Ship Equipment: deck gear and machinery. Cargo plans, stowage methods, ventilation and handling. Marine Communications Systems and Global Maritime Distress and Safety Systems (GMDSS). Hatch work and bulk heading. Rope work and boat rigging. Cargo protection. Anchor arrangements. Mooring and towing arrangements. Small boat handling with oars or engine. Mooring, anchoring, lowering mand lifting of life boats. Use of life saving equipment. First Aid, Personal survival. Merchant ship departmental organisation and station bills. Bridge equipment. Navigational Aids. Signalling and communications. International convention. Weather: types, impact and prediction. Climatology. Meteorological equipment and application in Navigation. Marine ecology. Practicals: Seamanship practice.

MAR 203: Introduction to Naval Architecture, and (3 Units E: LH 45)

Offshore Engineering

Learning Outcomes

At the end of this course, students should be able to:
1. identify and classify various marine vessels and offshore structures;
2. calculate different ship hull form coefficient and hydrostatic parameters;
3. explain the design sequence and procedures on ship design spiral;
4. perform basic stability calculation and analysis; and
5. implement numerical approximations for ship design and analysis.

Course Contents
Introduction to Naval Architecture: naval architectural terms and concepts; Ship building and the design spiral. Marine vessels: types of ships, boats, barges and floating structures. SHIP stability: The concepts of static, dynamic, intact and damage stability. Introduction to Offshore Engineering: types, design, installation, and operations. Fixed offshore and floating offshore platforms, Subsea systems, Introduction to offshore renewable energy systems.

300 level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;

5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;

5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers;
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

1. Design of machine components;
2. Product design and innovation;
3. Part modelling and drafting in SolidWorks; and
4. Technical report writing.

MAR 311: Marine Diesel Engines 1 (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. evaluate the thermal efficiencies of different theoretical and actual cycles;
2. distinguish between spark-ignition engines and compression-ignition engines;
3. determine the performance characteristics of internal combustion engines; and
4. explain diesel engine design considerations and features.

Course Contents

Theoretical and actual cycles. Fundamentals of internal combustion engines. Types of engines. Cylinder arrangements. Fuels and combustion. Performance characteristics. Engine ratings. Efficiency. Design and Construction. Fuel oil injection pumps and injectors. Ship propulsion engine types: direct and geared drive.

MAR 314: Marine Steam and Gas Turbines (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. evaluate the operating principles and efficiencies of thermodynamic cycles;
2. describe steam and gas turbines and combined power plants, their theory, design configurations and optimisation;
3. evaluate turbomachinery: theory, designs, performance and design limitations; and
4. explain the use of governors, safety devices, glands, couplings, seals.

Course Contents

Principles of operation and classification. Rankine cycle, reheat cycle, regenerative cycle, reheat/regenerative cycle and cycle efficiencies. Theory of steam expansion in cascade. Gas turbine. Principles of operation and classification. Brayton cycle, heat exchange cycle, reheat cycle, intercooled cycle, intercooler/reheat/heat exchange cycle, cycle efficiencies, combined steam and gas turbine cycles. Turbomachinery theory: Expansion of fluids in nozzles. Expansion process in turbine stator blades, work done in turbine rotors, velocity distribution across compressor and turbine, pressure, velocity and pressure-velocity compounding.

Steam turbine construction: Governors, safety devices, glands, couplings, Astern turbine, blades, rotors, blade fixing, seals, casings and condensers. Gas turbine construction. Rotors, compressor blades, intakes, combustors, turbines and exhausts.

MAR 323: Naval Architecture I (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. employ numerical techniques to estimate ship geometry and size;
2. determine and draw hydrodynamic curves;
3. calculate stability parameters of marine vessels;
4. perform inclining experiment of any floating marine vessel; and
5. analyse free-surface effect and the effect of loading on stability.

Course Contents

Ship's principal terms, geometry and hydrostatic calculation: ships lines, coefficients of form, wetted surface area, volumes, moments, displacement, tonnes per cm immersion and Bonjean curves. Simpson's rules, application to area, moments and volume calculations. Trapezoidal rule, mean and mid-ordinate rule, Tchebycheff's rule and their applications. Transverse stability of ships: Statical stability at small and large angles of heel, angle of loll; stability of a wall sided ship. Inclining experiment. Calculation of GM, BM, GZ and KM. Curves of statical stability and dynamical stability Determination of: Free surface effect. Centers of Buoyancy, and floatation. Centre of gravity: Effects of shifting, addition and removal of masses and of suspended masses. Trim: change in trim and draughts. Statutory Regulations; classification societies requirements; IMO Regulations.

MAR 352: Marine Electrical Tech and Instrumentation (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. perform basic installation, operation and maintenance of electrical systems;
2. explain onboard electrical system: their circuit diagram, calculations and safety;
3. describe the working principles of Motors and Starters; Traducers and indicators; and
4. perform circuit and insulation testing and over-current protection.

Course Contents

Ships' Electrical System: DC and AC systems: their circuit diagram, calculations and safety. Circuit and insulation testing and over-current protection. Main and standby generators. Main switchboard, circuit breakers and automatic voltage control. Motors and starters: types, ratings, operation, control equipment and maintenance. Auxiliary Electrical Services: Refrigeration and air conditioning; Galley and laundry; Cathodic protection and Battery Supplies. Special electrical practice for oil, gas and chemical tankers. Classification society's requirements for electrical equipment for: Bridge controls, Steering gears, and Navigation lights, basic electronics, operations and maintenance: alarm system, engine room telegraph, Radar and counter, Remote helm indicator, Echo sounder, Salinity indicators, smoke detectors, carbon dioxide recorder, Watertight door control, traducers for velocity, force, temperature, flow, pressure, displacement and position measurements. Output devices and feedback control systems. Electric propulsion –systems, engines, generators, motors, excitation system and control. Electrical faults detection, prevention and repair. Class requirements for spares on board. Simple electronics measuring devices, such as VTVM, CRO, IC tester, signal generator.

400 level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation; and
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them;
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MAR 417: Computer Aided Design (CAD) in Marine Engineering and Naval Architecture (2 Units E: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. evolve appropriate design philosophy, geometric/functional requirements, material selection criteria and manufacturing processes specifications;
2. draw, dimension, section and produce in diverse views the 2-D and 3-D drafting of engineering components in AutoCAD;
3. independently design, analyse, stimulate and render solid models of marine structures, mechanical systems and electrical devices; and
4. effectively utilise either autodesk inventor, SOLIDWORKS, Catia or Abaqus for parametric and feature-based design of engineering systems.

Course Contents

Review of marine/offshore engineering systems, structures, machines and components; their working principles, forces, stresses and deformations (calculations are not necessary, except for illustrations/comparisons). Engineering drawing concepts. Introduction to CAD environment. AutoCAD 2-D and 3-D drafting of mechanical and electrical components/systems. Projection views. Identification and uses of features and commands. Design Drawings: parametric and feature-based design. Geometric and dimensioning constraints. Design philosophy, geometric/functional requirements, material selection criteria, and processes requirements. Introduction to autodesk inventor/SOLIDWORKS/Catia, Abaqus. Generation of sketches, solid models, animation and analysis of system. Creation of multiple views, and orientations. Production of assembly drawings, section drawings and rendering. Limits, fits, tolerances and surface quality. Assembled drawings of pistons, thrust blocks, liners, connecting rods, crossheads, injection valves, hydraulic steering gear, turboshaft flexible coupling, safety vale starting valves, fuel pumps, stern tube and tail shaft, rudder carrier bearing and all accessories of main machinery. Libraries of standard machine elements and symbols.

MAR 421: Ship Resistance and Propulsion (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. analyse the various components of ship resistance and propulsion;
2. explain the hydrodynamics of ship in restricted water and in rough sea;
3. perform propeller design, matching to hull, performance evaluation, optimisation and cavitation prevention; and
4. describe ship maneuverability, sea-worthiness, form effects and powering.

Course Contents

Resistance of ship. Components of resistance. Laws of comparison. Model tests. Resistance in restricted water and resistance of small and fast ships. Methods of ship resistance calculations. Determination of engine power. Steering of ships. Types of rudders. Maneuverability. Seaworthiness of a ship. Fundamentals of ship; propulsion. Effects of hull forms, sea state and route constraints. Propulsion devices. Geometry of screw propeller. Momentum theory of the screw. Axial and tangential losses. The propulsion coefficients. The influence of after body on wake distribution. Model tests and laws of comparison. Systematic screw-series. Hydrodynamic characteristics. Matching of propeller to the hull. Cavitation. Design of screw propellers. Performance curves. The screw propellers performance in different load conditions. Controllable pitch propellers. Calculations, design and drawing of screw propeller.

MAR 423: Ship Structures And Strength (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. evaluate the loads, stresses and the strengths of structural members in ships and offshore facilities;
2. design and analyse the type of framing, shell plating, pillars and stiffeners for the different parts of a ship/offshore structure;
3. determine longitudinal bending moment and shear forces in still water, waves and on suspension; and
4. classify and calculate transverse strength, thermal stress and fatigue due to hull vibrations.

Course Contents

Loads acting on ship structure. Stresses in ship's structure: hogging, sagging, racking, pounding, panting, etc., and strength members to counteract the same. Types of ship structures. Framing systems. Classification rules. Function of ship structural components. Double bottom. Single bottom. Shell plating. Frames. Decks. Bulkheads. Pillars. Girders. Hatch coamings. Machinery casings. Superstructures. Bossing and struts. Bilge Keels and fenders. Determination of longitudinal bending moment and shear forces in still water. Wave bending moment. Total bending moment. Hogging and sagging. Dynamic forces. Local stresses. Torsion. Function of ship structure. Girder section moduli and stress. Deflection of ships. Transversal strength. Thermal effects. Strength of structure components. Local strength. Fatigue. Local vibrations. Reducing of hull vibration.

MAR 431: Marine Auxiliary Machinery (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. classify and evaluate marine boilers, heat exchangers & water distilling plants;
2. identify ship service systems and equipment (pumps & compressor systems, air-conditioning and refrigeration systems, heating and cooling systems, etc.); and
3. explain the application and theory of deck equipment, engine room equipment, steering gears, bow thrusters, stabilizers and fire-fighting systems.

Course Contents

Marine boilers and heat exchangers: Types, components, efficiency, sealing and cleaning. Steam condensers and water distilling plants. Ship service systems and equipment. Centrifugal separators. Fuel, lubrication, water and sewage treatment systems. Valves and pipelines: pipes, fittings, valves, etc. Pumps and pumping systems. Reciprocating centrifugal and rotary types. Principles of operation, pump head, efficiency performance curves and cavitation. Pump construction and installation. Corrosion and oxidation of metal, pipes, boilers, structural work; cracking of brass; minimising methods. Steam ejectors. Compressors and blowers: reciprocating, rotary and centrifugal, and performance. Deck equipment such as incinerators, engine room crane and accessories. Auxiliary power plants. Propeller shaft and shafting. Steering gears. Bow thrusters, stabilizers and stabilizing systems. Refrigeration. Heating, ventilation and air conditioning. Deck machinery and cargo equipment. Fire protection. Safety and safety equipment. Ship control and instrumentation.

MAR 433: Ship Engines and Power Plants II (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and analyse ship main engines (types and configurations such as CODAG, CODOG, COGAS and electric drives);
2. describe the general machinery layout and do proper heat balance analysis of power plants;
3. design power plant systems, propeller shaft, boilers and ship service systems; and
4. recommend power plants for special vessels (fishing vessels, tugs.).

Course Contents

Types of ship power plants and factors affecting the choice of power plant type. Ship main engines: Types and configurations, combined propulsion systems such as CODAG, CODOG, COGAS etc., and electric drives. General machinery layout. Heat balance analysis, overall efficiency determination and comparison across different power plant types. Design of power plant systems: Fuel oil systems, sea water cooling systems, lubricating oil systems, compressed air systems, steam systems, exhaust gas system, fresh water systems, automatic control and alarm systems. Propulsion shaft line arrangement, gear boxes, bearings and seals. Marine steam boilers: classifications, components, materials selection, principles of operation, instrumentation and automatic control. Boiler survey, corrosion mitigation and maintenance. Waste heat recovery systems. General purposes systems: bilge, ballast, water; firefighting. Rules and Regulations guiding design of ship power plants such as Lloyds register, American bureau of shipping, etc., and environmental protection requirements. Powerplants for special ship: fishing vessels, tugs/pushers tankers and passenger ships.

MAR 461: Offshore Systems Design and Analysis (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain field development, concept selection and class requirements;
2. undertake preliminary design of fixed and floating offshore structures, their design features, considerations and issues; and
3. correlate offshore facility design and the environmental forces for different return periods.

Course Contents

Overview of basic design concepts; environmental design considerations - wind, current and wave conditions for different return periods; field development and concept selection; design features, considerations and issues of fixed offshore structures; jacket structures, jack-up structures and compliant tower structures; design features, considerations and issues of floating offshore structures; FPSO systems, semi-submersibles, TLPs, Spars and design project.

MAR 465: Offshore and Coastal Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe offshore systems, design considerations and applications;
2. evaluate subsea field development, pipelines, Christmas trees;
3. explain most canonical underwater operations with the aid of AUVs, ROVs, and autonomous & semi-autonomous sub-marine robotics; and
4. give an overview of coastal facilities, piping system, underwater inspections, maintenance and repair operations.

Course Contents

Offshore systems & design; platforms, subsea development and pipelines; underwater operation & design; sub-marines, robotics and remotely vehicles design and applications, corrosion and cathodic protection; underwater inspections, maintenance and repair operations. Coastal engineering: Dredging and sand-filling mechanism and piping system; maintenance; design of breakwaters and jetties. Application of Bayesian, fuzzy and ANN software.

GET 499: Students Industrial Work Experience (8 Units C: 24 Weeks)

Learning Outcomes

At the end of this course, the students should be able to:
1. have industry familiarisation with machinery, processes, personnel, HSE procedures, ethics and local and International regulations;
2. undertake troubleshooting, overhauling and running of marine engines, gen set, motors, gears, injector, pumps, compressors, deck equipment, etc;
3. conduct inspection, maintenance and operation of freshwater generators, boilers, electrical system, safety gadgets, pipes and valves; and
4. perform workshop practices such as welding, turning, forming and heat treatment of machine components.

Course Contents

Supplement: During the SIWES periods, students are attached to marine industries or shipping companies to gain experience in research, design, operation, production, industrial processes, social and environmental services and the maintenance of ship's hull, Ship's???, power plants and machinery. Trouble shooting, maintenance and running of engines, generators, electrical equipment, instrumentation and machinery. Identification and inspection of components of machines. Dismantling, overhauling, inspection and assembling of pumps: centrifugal, hydraulic, gear, screw, reciprocating, variable displacement, sludge, etc. Maintenance, inspection and testing of fuel injector, air compressor, purifier and oily water separator, air bottle and mountings, plate type cooler, shell and tube type heat exchanger. Servicing, repair and operation of freshwater generator and reverse osmosis system; boiler safety valve; feed check valves; and gauze glass. General pipe and piping. Welding and fabrication of pipes, flanges, bolts, screws, etc. Practice of welding, brazing and soldering. Tracing, detection and repair of leaks on pipelines. Shaping, turning, cutting and machining operations by lathe machine.

500 level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MAR 513: Running and Maintenance of Ship Power Plants (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to describe the procedures for:

1. engine starting, running, stopping and logging;
2. troubleshooting, fault-diagnostics, maintenance of main and auxiliaries;
3. identification of wear, cracks and repair of damaged components; and
4. checking and adjustment of clearances, alignments, fittings and bolts.

Course Contents

Procedures for starting, running and stopping marine engines. Watch keeping, logging, fault diagnosis and maintenance of main and auxiliary engines. Overhauling, dismantling and checking of components for wear cracks and damage. Inspecting and overhauling of turbochargers, transmission systems, bearings, seals and filters. Testing of injectors, fuel pumps and valves. Repair/replacement of parts and assembly. Different maintenance methods and their significance. Checking and adjustment of clearances, alignments, fittings and bolts. General safety guidelines and machinery grinding-in procedure.

MAR 515: Ship Vibration and Rotor-dynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the phenomena of ship and shaft vibrations, modes, causes, effects, and attenuation procedures;
2. distinguish between torsional and lateral vibrations, free and forced vibration of single-degree and multi-degree of freedom systems;
3. calculate vibration parameters such as inertia, damping and stiffness coefficients; natural frequency, magnification, log decrement, etc;
4. apply both numerical and analytical methods for analysing multi-degree of freedom shafts; and
5. utilise vibration measuring instruments for measuring vibration modes, amplitude, frequency, phase angle and critical speed.

Course Contents

The phenomenon of vibration. Various modes of vibration onboard (free, forced, transverse, axial torsional – Their sources and effects), Free and forced vibration of single degree of freedom systems, natural frequency, damping, damping ratio and log decrement, base excitation, free and forced vibration of multi-degree of freedom systems, and vibration absorber. Numerical methods for multi-degree of freedom systems of shafts. Ship vibration and effects. Introduction to transient vibration theory, analysis and computer simulation. Vibration measuring instruments. Noise and vibrations: Elements of aerodynamic and hydrodynamic sources, noise and vibration suppression techniques, noise level measurement. Resonance and critical speed. Anti-vibration mountings of machines. Dampers with reference to torsional and lateral vibrations.

MAR 516: Refrigeration and Air-Conditioning (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss various refrigeration cycles and the working principles of their sub-systems such as compressors, evaporators, condensers, etc.;
2. explain the working principles of Brine system, refrigerated cargo holds, thermal insulators and their instrumentation;
3. state the design requirements for onboard systems such as heating, humidification, ventilation and air-conditioning systems; and
4. design, analyse and optimise the performance of ship borne air-conditioning system.

Course Contents

Refrigeration cycles and media. Systems, compressors, evaporators, condensers, receivers and expansion valves. Brine system. Cold stores, refrigerated cargo holds and freezers. Design methods. Thermal insulation. Instrumentation. Heating systems. Humidification. Ventilation of crew accommodation, cargo holds, engine and boiler rooms. Distribution and circulation of air and air-conditioning systems. Types: Analysis using psychometric chart. Air distribution layouts. Air-conditioning design. Maintenance procedure.

MAR 521: Ship Design and Construction (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. interpret the ship design spiral in-line with class rules and owner's requirements;
2. classify ships and other marine vessels according to their geometry, characteristics and functions;
3. determine ship principal dimensions & coefficients, loading & strength, intact & damaged stability, deadweight, freeboard & floodable length;
4. explain the fundamentals of ship construction and material selection for ship hull plating, framing, machinery mounting, superstructures, bilge Keels, fenders, etc; and
5. develop material joining procedure: welding procedures, riveting.

Course Contents

Basic concepts in ship design: Rules based on design principles, class societies rules and regulations, and ship design spiral. Classification of ships, their characteristics and functions. Modelling and analysis of ships, machinery, strength and performance. Determination of intact and damaged stability; statical and dynamical stability; and floodable length. Ship geometry and hydrostatic curves. Ship structures: Structural arrangement of ships. Fundamentals of hull vibration. Calculation of displacement; form coefficients; principal dimensions; deadweight and light-ship. Power vs speed calculation. Loadlines and freeboard parameters. Fundamentals of ship construction. Structural arrangements, framing systems, functions of ship, double bottom, single bottom, shell plating, etc. Decks, bulkheads, pillars, girders, hatch coamings, machinery mounting; superstructures deck houses, foundation laws and stern structures, bossings and struts, bilge keels and fenders. Ship sections and materials selection: materials joining processes. Testing of welds. Bottom and side framing. Deep tank and corrugated bulk heads. Fore-end and after-end-arrangements. Stem construction. Forepeak-collision bulk heads. Bulbous bows.

MAR 523: Naval Architecture II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. calculate and plot the hydrostatic parameters, form coefficients and stability curves;
2. explain the provisions of SOLAS convention in ship design and kitting;
3. calculate change of trim, draught due to loading, density change and flooding;
4. determine the factors of compartmentalization and loss of stability due to grounding;
5. calculate ship strength, deflections, ships and loading; and
6. analyse ship lines drawings, damaged stability and plotting of floodable length curves.

Course Contents

Ship body line design and calculation: ship's body plan drawing, Bonjean diagram and hydrostatic curves calculations and plotting. Ship stability: calculation and plotting of cross curves of stability by conventional and computer methods. Ship subdivision and damaged stability: calculation and plotting of floodable length curves. SOLAS convention. Longitudinal stability and trim: longitudinal BM, moment to change trim by one cm. Change of L.C.B. with change of trim. Change of trim due to addition, removal or shift of weights. Change of draught due to density and flooding. Flooding calculations and floodable length curves. Factors of compartmentalisation. Loss of stability due to grounding. Docking stability. Pressure on chocks. Strength of ships: loading diagram (buoyancy and gravity loads); shearing force and bending moment diagrams. Determination of B.M., longitudinal strength, moment of inertia, section modulus and deflection of ship. Balancing ship on wave.

MAR 525: Shipyard Technology (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to describe the procedure for:

1. hull assembly, outfitting, retrofitting, and machinery mounting;
2. slipway operation, dry docking, corrosion prevention and launching;
3. materials cutting, surface preparation, welding and riveting;
4. propeller-shaft assembling, engine room and deck machines installation; and
5. basic marine surveying of marine structures, systems and equipment.

Course Contents

Hull assembly on slipway. Slipway types and launching methods. Deflection of hull. Cutting, welding and riveting. Shipway arrangements. Machinery installation. Shaft Line and screw assembly. Boilers and auxiliary machines installation. Deck equipment. Masts, booms and cranes. Steering gears. Hatch covers. Mooring arrangements. Lifesaving equipment. Container fitting. Surface preparation and painting. Corrosion prevention. Superstructure outfitting. Fire-fighting arrangements. Inspection, tests and trials. Classification society requirements and certificates. Dry-docking. Hull cracks and crack arresting methods. HSE regulations and accidents prevention in ports and harbours.

MAR 531: Marine Diesel Engines II (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the procedures for engine performance determination and improvement;
2. describe low-speed diesel engines with respect to operations, starting air system, maneuvering, running in service, etc.;
3. recommend safety checks and devices as to preclude mishaps such as crankcase explosion and scavenge fire;
4. explain the dynamics of engine components, their vibrations and attenuation; and
5. highlight the fundamentals of tribology, i.e., bearings, seals and lubrication.

Course Contents

Engine performance: indicator, scavenging and supercharging turbocharging and turbochargers. Operation of low-speed engines starting air system and reversing mechanism. Controls and instrumentation. Starting (normal and stopping) operations. Overload operation. Maneuvering. Minimum speed operation in specific conditions. Typical operating troubles. Running in service safety devices. Dynamics of crank gear. Vibration: simple system, torsional, multi-cylinder crankshaft system: imbalance correction. Energy balance and engine efficiency calculations. Various cooling systems in I.C. engines; their merits and demerits. Safety and prevention of mishaps in I.C. Engines: causes and prevention of crank-case explosion and Scavenge fires. Detection of hazard and safety fittings provided to prevent damage. Fuel combustion in I.C. engines and air-fuel ratio. Grades of suitable fuels, preparation of fuels for efficient combustion. Fuel atomization and requirements of fuel injectors. Design aspects of combustion chamber. Fundamentals of tribology. Lubrication: theories, classification and characteristics. Types of lubricants: fluid and solid; their properties, applications, additives and limitations. Bearings and seals; theories, types and applications.

MAR 561: Basic Drilling Engineering (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain basic engineering principles of offshore hydrocarbon drilling and drilling systems;
2. describe basic geo-technics, oil well drilling: the drilling rig, hoisting, straight hole drilling and directional drilling (including slant and horizontal drilling); and
3. discuss casing design, cementing, blow out control, offshore drilling and recent advances.

Course Contents

To introduce the basic engineering principles of drilling for hydrocarbons on and offshore locations. To provide knowledge of drilling systems. To develop skills in order to design a drill string and to practise the power requirements for hoisting systems and the circulation of drilling fluid. The module provides a thorough grounding in the engineering principles of drilling for hydrocarbons on and offshore and an awareness of drilling systems. Topics include: geology and hydrocarbons, history of oil well drilling, the drilling rig, hoisting, drill string design, drill bits, rig hydraulics, straight hole drilling, directional drilling (including slant and horizontal drilling), fracture gradient, casing design, cementing, blow out control, offshore drilling and recent developments.

MAR 563: Subsea and Pipeline Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the requirements and challenges of deep-water oil exploration and field development;
2. perform basic design of subsea pipelines, risers, cathodic protection, etc.;
3. describe and state the significance of wellheads and Xmas trees, manifolds and well clusters, flowlines and pipelines, risers and umbilicals, etc.; and
4. discuss the procedure for the installation of SPS items, operation of ROVs, AUVs and pigging.

Course Contents

Deepwater field development and subsea engineering. Wellheads and Xmas trees; manifolds and well clusters; flowlines and pipelines. Subsea operation and control system. Installation of SPS items; divers/ROVs/AUVs. Subsea systems inspection, maintenance and repair. Deepwater risers and umbilicals. Flow assurance and system design. Introduction to design of subsea pipelines and risers. Pipelaying methods. Mechanical design considerations. Corrosion; wall thickness and material grade selection, seabed pipeline stability analysis, inspection and maintenance.

MAR 564: Ship and Offshore Hydrodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. estimate the environmental loads on fixed and floating offshore platforms;
2. model the dynamics of floating and fixed offshore structures under different metocean conditions;
3. perform statistical description of random seas and the induced structural responses; and
4. explain fluid flow phenomena such as flow separation, vortex shedding, vortex induced vibration (VIV).

Course Contents

Prediction of environmental loads on fixed and floating offshore platforms. Shallow- and deep-water wave theories. Dynamic responses analysis and experimental techniques. Dynamic modelling of offshore floating structures in waves. Fluid loading on slender offshore structures. Froude Krylov forces. Simplified diffraction forces. Introduction to the Morison equation – fluid phenomenon and force coefficients, variations on the basic formula and fluid loading calculations. Statistical description of random seas. Two-dimensional and three-dimensional wave spectra. Statistical description of response to environmental loading. Downtime analysis. Fluid load on slender bodies such as structural elements of fixed platforms and pipelines. Modelling of ships and offshore structures in incompressible viscid/inviscid flow. Fluid flow phenomena such as flow separation, vortex shedding, vortex induced vibration (VIV), etc. The concepts of added mass and wave diffraction by large volume structures- McCamy and Fuchs solution.

MAR 565: Mooring, Risers and Drilling Systems (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and analyse mooring systems, the different configurations and components;
2. evaluate mooring design criteria, constraints, equations and failure modes;
3. describe the different types of risers, their applications, design criteria and failures;
4. analyse soil interaction with risers and mooring systems; and
5. discuss the different mooring systems and their comparative advantages.

Course Contents

Mooring configurations: single-leg mooring, spread mooring, turret mooring; mooring components: wire ropes, synthetic fibre ropes, chains, clump weights, drag and suction anchors, piles; winches and windlass; single component and multi-component catenary equations; soil-mooring interaction; mooring failure modes; static, quasi-static, and dynamic mooring analyses; mooring design criteria and considerations. Drilling risers, production risers: flexible, steel catenary; flexible riser configurations: steep/lazy S and wave, free hanging; flexible riser components: bend stiffeners/ bell-mouths, unbonded/bonded flexible risers, bend restrictors; rigid riser components: tieback connectors, stress joints, riser joints and connectors, buoyancy modules, tensioners; riser casing; soil-riser interaction; riser failure modes; structural riser analysis; static and dynamic riser analyses; interference analysis; riser design criteria and considerations.

Minimum Academic Standards

Equipment

Minimum Standards for Laboratories/ Workshops

Although other laboratories and workshops not listed here will be shared with many other departments in the faculty and University in general, the laboratories and facilities listed in the table below should be provided and equipped specifically for every Marine Engineering degree programme. Each laboratory or workshop should have sufficient working spaces with safety equipment and relevant manuals.

Marine Engineering Workshop Equipment

Metalworks and Fabrication Section

1. Work benches with vices for metal work
2. Tool boxes containing hand tools such as screw drivers, wrenches, hammers, hacksaws, files, centre punch, chisel, scrapers, etc.
3. Lathe machines
4. CNC lathe machine
5. Milling machines
6. CNC milling machine
7. Drilling machines
8. Grinding machines
9. Folding machines
10. Power hacksaw
11. Shaping machines
12. Tennoning machine
13. Vertical mortising machine
14. Dovetailing machine
15. Vernier Callipers and Micrometer Screw Gauges
16. Sheet metal folding machine
17. Furnaces (heat treatment facility)
18. Casting facilities
19. Arc welding machines and accessories
20. Gas welding facilities
21. Safety gadgets and first-aid equipment (for fire, electric shocks, impact, etc.)
22. Personal protective equipment (for eye, skin, ear, etc.)
23. Pop riveting machine
24. Guillotine cutting Machine
25. Rolling machine, etc.

Carpentry & Woodwork Section

1. Band saw, radial arm saw and circular saw
2. Surfacing machine
3. Mortise machine
4. Thicknessing/Planing machine
5. Wood Lathe machine
6. Portable sander machine
7. Jig saw, rip saw, cross-cut saw, panel saw, tenon saw, compass saw
8. Drilling machine
9. Chest drill
10. Spraying machine
11. Oil stone
12. Wood workbenches with vices
13. G clamp, F clamp, Sash clamp
14. Jack planes, smooth planes
15. Other hand tools such as tri square, claw hammer, pincer, marking gauge, mortise gauge, spirit level, flat chisel, wood rasp, round chisel, wood mallet, spoke shave, screw drivers, tape rule, scraper, etc.

Marine Electrical Section
1. Water distillers
2. Hydrometers
3. Multi-meters, voltmeters, ammeters and clamp meters
4. Soldering irons
5. Battery chargers
6. Standard tool boxes for electrical and electronics works
7. Electrical/electronics data books
8. Oscilloscopes
9. Tachometers and phase sequence meters
10. Logic probes
11. Etching machines complete with accessories
12. Coil winding machine, etc.

Drafting and Design Studio
1. Drawing tables and chairs
2. Drawing boards, T-squares and instruments
3. Automatic drafting machine
4. Drafting gadgets, stencils, etc
5. Automatic stencil cutter
6. Computer studio or workstation with at least 50 computers
7. Computer graphics and design hall with necessary design software (e.g. AutoCAD, Maxsurf, SACS, Orcaflex, Flexcom, SolidWorks, Inventor, etc.)
8. 3-D printer

List of Marine Laboratories

S/NO	LABORATORY/FACILITY	EQUIPMENT/MACHINERY
1	Marine Engines and Auxiliary Machinery	Engine test bed (4- or 6-cylinder turbocharged diesel engine on an engine test bed with dynamometer and computer interface).
		Steam turbine and boiler model Gas turbine model Internal combustion engine model Two-stage compressor Injector testing machine
2	Simulation Laboratory	Ship navigation simulator Dynamic positioning simulator Engine room simulator Wave simulator
3	Rotordynamics and Vibration	Rigid-rotor balancing machine Bentley Navada rotor Kit Vibrometer Proximeters and displacement sensors Piezoelectric accelerometers Voltage-regulator inverter Fast-fourier transform (FFT) analyzer + frontend
		Offshore structure models Ship models

4	Marine Structures/ Hydrodynamics	Fluid bench Wind tunnel Offshore basin and/or Towing tank Carriage for model Wave makers Underwater Camera (HD) U-tube oscillating water tunnels Cavitation tunnels.

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and

3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
Supplementary to the university and faculty libraries, the programme must have adepartmental library well equipped with specialized books, journals, periodicals and bulletines in both physical collections and E-collections from credible academic and professional sources. A compendium of field and research reports of the programme must also be available in the library for staff, students and researchers. In addition, the library must subscribe to the intellectual property/ repositories of:

1. Renowned academic institutions (national and international);
2. Open access sources and E-learning platforms; and
3. Relevant local and international professional Bodies.

The library must also have adequate facilities for:

1. Internet services;
2. Reading and e-learning; and
3. Lending and reservation of specialized materials.

Classrooms, laboratories, Workshops, Clinics and Offices
The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Materials and Metallurgical Engineering

Overview

This curriculum is designed for Bachelor of Engineering (B.Eng.) degree programme in Materials and Metallurgical Engineering. Materials and Metallurgical Engineering is an exceptionally broad field that includes inter-related engineering disciplines: Mineral Processing, Extractive Metallurgy, Physical Metallurgy, Materials Engineering and Materials Processing. Adequate courses have been developed in the areas of Mineral Processing (the initial step in Extractive Metallurgy); Extractive or Process Metallurgy (recovering and refining of metals and other valuable products from mineral concentrates, scrap, and other materials); Physical Metallurgy (processing of metals into products by alloying, forging, welding, and casting to control chemical, physical and mechanical properties); Materials Engineering and materials Processing (development of best materials for applications involving ceramics, glasses, polymers and composites in addition to metals). The programme strives to keep pace with industrial and societal needs by offering a relevant selection of elective courses in each discipline. The overall fifteen (15) credit units attached to the industrial training throughout the duration of this programme guarantees a robust training of students.

Philosophy

The programme strives to consistently provide excellence in learning, research and service through globally relevant curricula that guarantee materials and metallurgical graduates with strong scientific and engineering problem-solving knowledge appropriate for understanding the link between the underlying structure and the processing, properties and performance of materials development and applications.

Objectives

The objectives of the Materials and Metallurgical Engineering programmes are to:

1. train the students through integrated learning in classroom, laboratories and field trips to the industry;
2. provide sound academic foundation as basis for the pursuit of higher degrees (M.Sc., M.Phil. and Ph.D);
3. provide the learners with a fundamental knowledge base associated with Materials Processing, properties, performance, selection and application in relation to the underlying structure;
4. produce graduates that will be competently involved in the practice of Metallurgical and Materials Engineering or perform successfully as members of professional teams or capable of pursuing graduate studies;
5. develop in the learners adequate and appropriate experimental design and implementation, and technical report writing skills for the purpose of disseminating information on Metallurgical and Materials Engineering;
6. enable the graduates to apply the core concepts of Metallurgical and Materials Engineering to solving engineering problems; and
7. ensure sustainable research and development culture in consonance with trends in the metallurgical and materials industry, public service and the global community; and
8. produce graduates that understand professional and ethical responsibilities of a metallurgical and materials engineering field.

Employability Skills

The graduates of this programme will acquire a well-balanced engineering education with emphasis on Materials and Metallurgical Engineering in order to meet the needs of industry, academia, government and the society. The graduates will be engineered to innovate in materials, energy, electronics, medicine, communications, transportation, recreation, structural and domestic fields. The graduates are expected to display outstanding skills ranging from synthesis, processing, design and development to manufacturing, performance, reclamation and recycling of materials.

Materials and Metallurgical engineers produced should be competent and technically equipped to develop materials suitable for the needs of the various sectors of human life while eliminating/minimising environmental pollution and degradation through development of technologies for safe and healthy recycling of wastes. They should also be able to provide technical services needed to run and maintain industries and establishments such as, iron/steel based industries, aluminium based industries, materials, materials testing laboratories, power metallurgy firm, ceramic industries, polymer production firm, automobile industries, aviation industries, maritime firm for repair, maintenance, construction of ships and boats, oil and gas industries, defence industry, electronics (semi-conductors), energy, communication, rehabilitative medicine (biomedical), consulting, research and development. They should have the capability for self-employment and engaging in entrepreneurship'

21st Century Skills

The Materials and Metallurgical Engineering programme involves the development of 21st century skills as listed below:

1. critical thinking/problem solving/decision making;
2. collaboration (teamwork);
3. communication;
4. creativity and innovation;
5. information literacy;
6. learning to learn/metacognition;
7. citizenship (local and global);
8. Ability to handle high professional and ethical responsibilities; and
9. Ability to work effectively and efficiently with interdisciplinary teams.

Unique Features of the Programme

The current Materials and Metallurgical Engineering programme compares very well in content to similar programmes in other universities around the world, some of which have been running Materials and Metallurgical Engineering programme for more than a century and are top ranking among institutions for higher learning worldwide. The entrepreneurship and innovation training injected into this programme will give the graduates of this programme the needed entrepreneurial skills which is a new innovation. The strengthening of Industrial Training (IT) is another innovation and uniqueness of this new curriculum.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 levels respectively.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Sciences	Faculty/ (GET)	Departmental (MME)	SIWES courses	Total Units
100	4	16	3	2	-	25
200	4	-	22	-	3	29
300	4	-	15	8	4	27
400	-	-	-	8	8	8
500	-	-	5	14	-	16
Total	**12**	**16**	**45**	**32**	**15***	**105**

*All 15 SIWES units to be credited in the 2nd Semester of 400-Level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English,	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
MME 102	Introduction to Materials and Metallurgical Engineering	2	C	30	-
Total		**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 203	Engineering Graphics and Solid Modeling II	2	C	15	45
GET 204	Student Workshop Practice	2	C	15	45
GET 205	Fundamental of Fluid	3	C	45	

	Mechanic				
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
Total		**26**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	R	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy System and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
MME 301	Thermodynamics of Materials	2	E	30	-
MME 304	Chemistry of Materials	2	E	30	-
MME 305	Engineering Materials: Structure and properties	2	C	30	-
MME 312	Physical Metallurgy I	2	C	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
Total		**23**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
MME 401	Synthesis, Processing and Manufacturing of Materials	2	E	30	-
MME 405	Corrosion Science and Engineering	2	E	30	-
MME 407	Mechanical Behaviour of Materials	2	E	30	-
MME 413	Chemical Metallurgy	2	E	30	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
Total		0			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I: *SWEP*	3	C	9 Weeks
GET 399	SIWES II	4	C	12 Weeks
GET 499	SIWES III	8	C	24 Weeks
Total		**15***		

*All credited in the 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MME 501	Analytical Methods for Materials	2	E	30	-
MME 504	Solidification and Foundry Technology	2	E	30	-
MME 505	Nanoscience and Nanotechnology	2	C	30	-
MME 507	Composite Materials	3	C	45	-
MME 510	Project	6	C	-	270
Total		**16**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements.

Writing activities (pre-writing (brainstorming and outlining), writing [paragraphing, punctuation and expression], post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and

5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;

8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;

6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;

4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;

5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents
Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
6. conduct measurements of some physical quantities;
7. make observations of events, collect and tabulate data;
8. identify and evaluate some common experimental errors;
9. plot and analyse graphs; and
10. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MME 102: Introduction to Materials and Metallurgical Engineering
(2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. solve materials and metallurgical engineering problems using mathematics, science and technology;
2. design components, systems, and processes for materials and metallurgical engineering based on engineering, economy, energy, environment and sustainability;
3. formulate decisions based on data analysis, information, experiments, and practical experience;
4. identify, analyze and formulate alternative solutions for materials and metallurgical engineering;
5. apply modern tools for engineering design and analysis;
6. plan, complete and evaluate tasks within existing constraints as required;
7. work in inter-disciplinary and inter-cultural teams nationally and internationally;
8. be responsible to society and comply with professional ethics in solving problems in materials and metallurgical engineering; and
9. communicate effectively, both orally and writing.

Course Contents

Historical development of Materials and Metallurgical Engineering. Differentiation between materials and metallurgical engineering. Role of materials and metal products in human civilization: Stone age, copper age, iron age, nuclear age, ICT age; imagine the world without materials and metals. Study Periodic Table; classification of metals; Materials and Metallurgical Engineering: definition and classification: Process (Extractive) metallurgical engineering. Get acquainted with terms like roasting calcination, agglomeration, smelting, smelters contract, refining and furnaces. Physical metallurgical engineering: structure - property -application relationship. Mechanical metallurgical engineering: Stress - strain relationship and application. Study of properties and applications of materials of construction or manufacture: ceramics, metals, polymers, and composites. Materials and Metallurgical engineering: ferrous, non-ferrous and other materials industries as basis for industrialisation and national economic development. Nigerian materials and metallurgical industry; professional bodies such as Nigerian Society of Engineers, Nigerian Metallurgical Society (NMS), Materials Science and Technology Society (MSN).

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;

7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units: C, LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modeling II (3 Units: LH 30; PH 45)

Learning Outcomes
Students should:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents
The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal

spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke’s and Green’s theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles

of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;

4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

MME 301: Thermodynamics of Materials (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the laws of thermodynamics and their applications to equilibrium and the properties of materials;
2. discuss how thermodynamics affects materials microstructure, defect concentration, atomic ordering etc;
3. analyse equilibrium conditions between solid-liquid, gas-liquid and gas-solid phases in one-component systems;
4. calculate equilibrium conditions between solid-liquid, gas-condensed phases via the Clapeyron equation;
5. explain how the properties of materials are affected by thermo processes;
6. discuss how to develop graphical constructions that are essential for the interpretation of phase diagrams;
7. explain how to apply thermodynamic data to predict stable phases in high temperature systems;
8. explain the construction and use of partial pressure diagram, Eh-pH diagrams, T-C diagrams in metallurgical systems; and
9. discuss slag formation equation and desulphurization process metallurgical system.

Course Contents

Thermochemistry applied to typical metallurgical reactions, graphical representations of equilibria, binary and ternary phase diagrams, heterogeneous equilibrium, behaviour of solutions, standard states, and electrochemical thermodynamics. Application of thermodynamic data to predict stable phases in aqueous and high-temperature systems. Construction and use of partial pressure diagrams, Eh-pH diagrams, temperature-composition diagrams in related mineral and metallurgical systems. Activities and equilibria in slag-metal and gas-metal systems.

MME 304: Chemistry of Materials (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the chemistry behind the following materials: metals, ceramics, and polymers;
2. describe historic and economic impacts of materials manufacture and use;
3. discuss the application of chemistry principles to Materials Engineering using flowsheet;
4. explain the use of chemistry in reactor design; and
5. discuss the applications of advanced materials in fields such as electronics, aviation, or art.

Course Contents

Basic Inorganic Chemistry of Materials. Topics will include chemical properties, structure and bonding of solids, energy, enthalpy, entropy, thermochemistry, kinetics and rate processes. Application of chemistry principles to Materials Engineering through flowsheeting, reactor design, materials/metals processing and the environment.

MME 305: Engineering Materials: Structure and Properties (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify the following engineering materials: metals, ceramics, polymers, and composites -- their structures and properties;
2. explain the structure-property relationships for engineering materials;
3. discuss the manufacture, processing and applications of engineering materials.

Course Contents

Basic structure of ceramics, alloys, composites, metals, and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal, and chemical properties.

MME 312: Physical Metallurgy I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and explain various metallurgical reactions e.g. eutectic, peritectic, monotectic, eutectoid etc;
2. draw iron–carbon/carbide and iron-graphite equilibrium phase diagrams;
3. describe the Fe-C/CO_3 in order to classify steel and cast irons according to composition and structures;
4. identify room temperature solidification structures of steel and cast irons;
5. describe the cast structures of steels and cast irons;
6. describe the effect of cooling on structure of steels;
7. discuss the applications of steels and cast irons;
8. explain the heat treatment processes/structures of as-cast and worked steels and cast irons;
9. explain the alloying of metals – ferrous and non-ferrous metals;
10. explain the hardening and tempering processes for steels, cast irons and non-ferrous metals; and
11. explain the different types of high alloy steels, heat treatment and applications.

Course Contents

Introduction to metals and metal alloy systems. The metallic bond and structure of metals. Solidification of pure metals, effect of variables on structure solidification as a nucleation and growth process. Solidification of non-crystalline materials. Preparation of materials to reveal structure, use of microscope, annealing of metals, grain growth, surface energy and shapes of crystals. Deformation, slip, twinning, effect of microstructure, viscous flow. Annealing of deformed metals. Effect of variables. Binary equilibria - alloying, solid solutions. Equilibrium of phase diagrams, complete solubility, Cu/Ni type, Lever rule. Effect of cooling changes in solid, heterogeneous equilibria, Claudius - Chaperon on vapour pressure, phase rule, definitions and proof. Introducing activity and potential P-T diagrams,

condensed systems. Peritectics, more complex equilibrium diagrams with maxima, minima compounds, etc. Iron - iron carbide diagram, hysteresis, allotropy.
Applications-- cast steel, wrought steels, effect of cooling on structure of steels. Martensite. Quenching, T.T.T. curves, hardenability. Bainite, alloying. Tempering properties and structure. Surface hardening. High alloy steels, cast irons, stability Fe3C, Iron-graphite equilibrium. Copper, copper -- zinc alloys as an example of different strengthening processes.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MME 401: Synthesis, Processing, and Manufacturing of Materials (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the synthesis of materials such as principal alloys, ceramics and polymers;
2. differentiate between synthesis and processing;
3. discuss the processing of engineering materials – metals, ceramics and polymers;
4. explain how changes in materials properties enhance the performance of the material;

5. discuss the common manufacturing and processing methods for metals, ceramics, and polymers;
6. describe five casting techniques; and
7. explain the addition and condensation polymerisation mechanisms.

Course Contents

Detailed study of principal alloy, ceramic, and polymer systems. Evaluation of the effects or processing on selected physical and mechanical material properties. Overview of design fundamentals and examination of selected material/design case studies for manufacturing.

MME 405: Corrosion Science and Engineering (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the basic concept of corrosion and socio-economic implication;
2. describe the fundamental causes of corrosion problem and failures;
3. explain the thermodynamics and kinetics of electrochemical reactions in corrosion of metals and alloys;
4. describe the various forms of corrosion (from uniform to localised to stress corrosion phenomena);
5. use Pourbaix and Evans diagrams as tools to predict corrosion;
6. discuss corrosion rate measurements using weight loss method and other methods; and
7. discuss the protection systems used to combat corrosion, including inhibitors, coatings and cathodic protection.

Course Contents

The course is aimed at investigating the underlying fundamental causes of corrosion problems and failures. Emphasis is placed on the electrochemical reactions occurring and the tools and knowledge necessary for predicting corrosion, measuring corrosion rates, and combining these with prevention and materials selection.

MME 407: Mechanical Behaviour of Materials (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the mechanisms for mechanical behaviour of materials;
2. explain the similarities and differences in mechanical response within and between the material classes; and
3. discuss stress, strain, tensors, elasticity, dislocations, strengthening mechanisms, high temperature deformation, fracture, and fatigue.

Course Contents

Flow and fracture of solids; uniaxial stress-strain as a reference behaviour; theories of terminal stability under impact; monotonic, sustained (creep), and repeated (fatigue) loadings of solids under various states of stress.

MME 413: Chemical Metallurgy **(2 Units E: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the quantitative thermodynamics, fluid flow, heat and mass transfer and its application to process metallurgy;
2. explain the fundamental chemical principles and demonstrates the application of these principles to process metallurgy;
4. explain the fundamental chemical principles involved in metallurgical reactions; and
5. discuss the applications of the chemical principles to the extraction and refining of metals, metal melting and recycling, and metallic corrosion.

Course Contents
Application of thermodynamics, fluid flow, and heat and mass transfer to the design and operation of chemical metallurgical processes; roasting, agglomerating, oxidation and reduction reactions, smelting, converting, and refining.

500 Level

GET 501: Engineering Project Management **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law **(2 Units C: LH 30)**

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MME 501: Analytical Methods for Materials **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the external morphology of crystals and law of constant angle;
2. explain representation by directions of ace normal;
3. discuss Crystal Chemistry - ionic, covalent, metallic and Van der Wall's bonded crystals;
4. explain the physics behind X rays, it's production, properties and applications in radiology;
6. explain the principles of diffraction, atomic Scattering, Bragg's equation and missing reflections;
7. explain the principle of electron and neutron diffraction method; and
8. discuss how spectroscopy and spectrometric analysis can be used to study materials.

Course Contents

Crystallography, physics of X-rays, diffraction by crystalline materials, applications of X-ray, electron and neutron diffraction, and spectrometric analysis of materials.

MME 504: Solidification and Foundry Technology **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. select appropriate casting method for particular component;
2. explain the production of various engineering components;
3. identify properties of cast products; and
4. discuss areas of application of cast component.

Course Contents
Processes of freezing: nucleation and growth of solid phase; Plannar and dendritic growth freezing of alloys; constitutional super-cooling. Solidification of two-phase alloy; structure of cast alloy; effect of cast structure on properties; segregation in ingots. Casting techniques and finishing operations; defects in casting.

MME 505: Nanoscience and Nanotechnology (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify and control individual atoms and molecules;
2. make materials at the nanoscale deliberately;
3. explain enhanced properties of nanomaterials such as higher strength, lighter weight, increased control of light spectrum, and greater chemical reactivity than their larger-scale counterparts; and
4. apply nanoscale materials particles to create changes in the composition of the materials.

Course Contents
Fundamental concepts in nanoscience and nanotechnology. Review of quantum mechanics. Nanosystems. Molecular dynamics. Scanning probe microscopy. Nanomaterials. Production and characterization of nanoparticles. Design of nanostructured systems. Nanomechanics of materials, Applications of nanosystems in the industry. Carbon nanofibres, Nanocomposites. Fabrication methods. Computational nanotechnology.

MME 507: Composite Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. produce advanced engineering materials;
2. describe the production, characteristic and applications of hybrid composites;
3. discuss the mode of failure in composites; and
2. discuss the application of composites in various engineering fields and other areas.

Course Contents
Fundamental aspects of modern composite materials; types of composite materials viz: fibre, reinforced, particulate dispersion strengthened and laminar types, Metal matrix composites, Ceramic matrix composites, polymer matrix composites, and hybrid composites. Methods of fabricating composites; solid state and liquid state fabricating techniques; characteristics and properties of composites; measurement and testing of properties of composites; application of composites in engineering design; failure modes of composites.

MME 509: Final Year Project (6 Units C: LH270)

Learning Outcomes
The student(s) will develop a technology and/or system to solve a known and significant materials and metallurgical engineering problem and design, and if possible/practicable, build/produce/ manufacture some relevant new naterials/device(s) representing the solution using the skills acquired in the programme.

Course Contents
Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the engineering degree.

MME 514: Engineering Materials Laboratory (1 Unit C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the various laboratory procedure and methods for engineering materials;
2. discuss principles and different methods of hardness measurement;
3. discuss the correlations among different types of hardness measurement and correlations of hardness with tensile strength;
4. use various types of hardness testers;
5. use a computer-controlled universal testing machine (UTM) to perform standard tensile test and test procedure;
6. observe the tensile behaviour of metal and polymer materials,
7. explain material properties from stress-strain curves obtained from tensile tests and methods for toughness measurement with impact tests;
8. discuss the procedre for specimen preparation for macro and microscopic examination, compound optical microscopes and metallography.
9. describe the heat treatment principles and methods; and
10. examine surface characteristics of engineering materials.

Course Contents
Materials testing and evaluation, laboratory procedures and techniques, metallography, heat treatment, phase diagrams, hardenability, and mechanical testing.

Minimum Academic Standards
Equipment
List of Laboratories/Workshops/Equipment/Instruments/Tools

Foundry Laboratory
1. Melting furnaces (Crucible, Electric arc, Rotary)
2. Oil fired crucible furnace
3. Sand moulding equipment
4. Sand testing equipment
5. Crucibles of various sizes
6. Moulding sands
7. Sand blasting machines
8. Pattern making machine
9. other foundry accessories
10. Scale balance
11. Digital weighing balance
12. Scraps yard

Heat Treatment Laboratory

1. Heat treatment furnaces (1000°C, 1200°C, 1800°C, 2000°C)
2. vens (200, 300, 600°C)
3. Salt bath furnace and accessories
4. Thermocouples of various temperatures
5. Pyrometer
6. Quenching bath (Oil & water)
7. Jominy end quench apparatus

Machining Workshop
1. Lathe machine (Standard)
2. Drilling machine
3. Boring machine
4. Power cutting machine
5. Bench vices
6. Files of different sizes
7. Cooling lubricants

Metallography Laboratory
1. Thin sectioning machine and the discs
2. Hot/Cold mounting machines and accessories
3. Automatic grinding/polishing machines and accessories
4. Hot/cold sample mounting materials
5. Optical microscopes (x1000) with inbuild camera
6. Image analyser
7. Scanning Electron microscope (SEM) with EDS
8. X-ray Differential machines, AAS
9. Etchants
10. Desiccators
11. Air drier
12. Metal Analyser
13. Fume cupboard

Minimum of 10 Desktop Computers
Minimum of 15 Laptop Computers (1TB HDD,500GB Memory, Webcam, Internet ready)

Materials Testing Laboratory
1. Universal tensile test machine
2. Hardness tester machine (BHN, Vickers & Rockwell)
3. Impact energy testing machine
4. Fatigue/creep testing machine

Corrosion Testing Laboratory
1. Potentiometer equipment and the kits
2. Digital weighing balance scale

Welding and Fabrication Workshop
1. Arc welding machine
2. Gas welding machine
3. Oxygen gas and accessories
4. Acetylene gas and accessories
5. Electrodes of different types
6. Electrode holders

7. Other welding accessories (hand gloves, eye goggles, boots)

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

1. There should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. Each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. There should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

Subject to the general standards specified by NUC, the central and/or faculty/departmental libraries should have:

1. Physical holdings of current books in the relevant fundamental science and engineering subject areas;
2. Physical holdings of current books in the core mechanical engineering subject areas;
3. Physical holdings of current journals in the core materials and Metallurgical engineering subject areas;
4. E-subscription of current books in the relevant fundamental science and engineering subject areas;
5. E-subscription of current books in the core mechanical engineering subject areas; and
6. E-subscription of current journals in the core mechanical engineering subject areas.

Classrooms, Laboratory, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Mechanical Engineering

Overview

Mechanical engineering is the application of the principles of physics (namely of motion, energy, and force), mathematics, materials science and engineering problem-solving techniques to the design, analysis, manufacture, operation and maintenance of mechanical systems while ensuring competitive costing, safety, reliability and efficiency of such systems. The mechanical engineering discipline employs contemporary design tools such as computer-aided design (CAD), computer-aided manufacturing (CAM), and product lifecycle management tools to analyse and design a wide variety of systems.

This curriculum is designed in line with contemporary global trends in Mechanical Engineering education; emphasising development of materials, mass, momentum and energy balances leading to the geometric description of conservation laws of nature. These lead to several important constitutive models and multiphysics in special fields such as:

1. Linear and nonlinear mechanics Applied (solid) Mechanics (involving the analysis of the behaviour of solid bodies subjected to external loads, stresses and/or vibrations and using the information in the design and manufacture/construction of such bodies)
2. Fluid Mechanics (involving the analysis of the behaviour of liquids and gases and employing the knowledge in the design and development of machinery and systems that can and/or do influence that behaviour – pumps, fans, turbines, piping systems, *et cetera*)
3. Thermal Engineering [including Thermodynamics and Heat Transfer] (involving the analysis of the conversion of thermal energy into work and/or other forms of energy and thermal energy transport and employing this knowledge in the design and development of energy conversion devices and systems, e.g., power plants, engines, heating, ventilation & air conditioning (HVAC) systems, etc.)
4. Mechanical Design and Manufacturing Engineering (covering the full range of mechanical-based products and systems); arising from the above engineering sciences synthesized together into modern software solutions of the resulting complex equations that, added to 3D Solid models, simulation analysis and optimization produce useful design tools
5. Industrial Engineering and Management Sciences

Philosophy

The philosophy of the programme is to produce self-reliant and confident graduates who can bring their academic and practical backgrounds to bear on the problems of industry and the larger Nigerian society. The academic programme has been planned to challenge and encourage students towards developing ingenuity and originality in problem solving. The cornerstone of this is an early grounding in the basic engineering sciences and a strong emphasis on applied design in later years.

Objectives

The objectives of the undergraduate Mechanical Engineering programme are to prepare its graduates to:

1. actively engage in engineering practice or in other fields, such as education, science, business, public policy, politics or governance for sustainable development;
2. retain intellectual curiosity that will motivate them to pursue meaningful lifelong learning via graduate education in engineering or related fields, participation in

professional development and/or industrial training courses, and/or obtain engineering certification;

3. develop successful careers as mechanical engineers and apply their mechanical engineering education to address the full range of technical and societal problems with professional engineering competence, creativity, imagination, confidence and responsibility;
4. occupy positions of increasing responsibility and/or assignments and aspire to positions of leadership within their profession for enhanced community participation and qualitative service delivery; and
5. exhibit the highest ethical and professional standards, and, as agents of positive change, communicate the importance and excitement of Mechanical Engineering.

Unique Features of the Programme

Some unique features of the programme include:

1. stimulating intellect and encouraging students towards developing ingenuity and originality in problem solving;
2. encouraging students to maintain intellectual curiosity that will motivate them to pursue meaningful lifelong learning; and
3. equiping students with the relevant intellectual capacity, contemporary software proficiency, communication, entrepreneurial and
4. other relevant soft skills like teamwork, flexibility, adaptability and interpersonal knack to engage effectively in engineering practice, business and in leadership roles.

Employability Skills

Graduates of this programme may find jobs in diverse sectors as:

1. in the automobile, aerospace, biomedical, building and construction, food and beverages, manufacturing, oil and gas, power, petrochemical and process, railway and telecommunication industries;
2. industrial systems engineers, product designers, managers, researchers, applied mathematicians, and, of course, performing a multitude of other traditional Mechanical Engineering duties; and
3. to become Entrepreneur (employer of labour in field relating to mechanical engineering).

The curriculum is designed to:

1. equip graduates of the Mechanical Engineering programme with the intellectual capacity (to apply the principles of physics, mathematics, materials science and engineering problem-solving techniques) and relevant contemporary skills;
2. offer students skills that are highly sought after and highly remunerated in industry;
3. prepare graduates to undertake the challenge of working on a wide range of projects, with the prospect of working with a broad spectrum of other professionals; and
4. develop successful careers as mechanical engineers and apply their mechanical engineering education to address the full range of technical and societal problems with professional engineering competence, creativity, imagination, confidence and responsibility.

21st Century Skills

The programme emphasises such contemporary skills as:

1. developing ingenuity and originality in critical thinking/ problem solving/decision making;
2. creativity and innovation;
3. information literacy;

4. intellectual curiosity that will motivate them to pursue meaningful lifelong learning;
5. contemporary software proficiency;
6. effective communication skills;
7. entrepreneurial capability;
8. collaboration (teamwork and work ethic);
9. Flexibility and adaptability; and
10. Learning how to learn/metacognition.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Discipline GET	Programme (MEE)	SIWES	Total Units
100	4	18	3	1	-	26
200	4	-	26	-	3	33
300	4	-	15	0	4	23
400	-	-	-	2	8	10
500	-	-	5	8	-	13
Total	**12**	**18**	**52**	**23**	**15***	**105**

*All 15 SIWES units credited in the 2nd Semester of 400-Level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 103	General Physics III	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
MEE 101	Introduction to Mechanical Engineering	1	C	15	-
Total		**26**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I	3	C	9 wks	
Total		**30**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	E	45	-
GET 304	Technical Writing and Communication (including Seminar Presentation Skills)	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
MEE 306	Computer-Aided Design and Manufacture	1	E	-	45
*GET 399	SIWES II	4	C	12 wks	-
Total		**19**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
MEE 401	Mechanical (Machine) Engineering Design II	2	C	30	-
MEE 402	Theory (Mechanics) of Machines I	2	E	30	-
MEE 403	Applied (Engineering) Thermodynamics I	2	E	30	-
MEE 404	Applied Fluid Mechanics	2	E	30	-
MEE 405	Heat and Mass Transfer	3	E	45	-

MEE 407	Advanced Mechanics of Materials	2	E	30	-
*GET 499	SIWES	8	C	24 wks	-
	Total	**2**			

SIWES Courses

Course Code	**Course Title**	**Units**	**Status**	**LH/PH**
GET 299	SIWES I: SWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24weeks
Total		**15***		

* All credited in the 2nd Semestter of 400-level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering (Project) Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MEE 501	Applied Design	2	C	15	45
MEE 590	B.Eng. Project	6	C	-	270
Total		**13**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing

(summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;

8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and

7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;

4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:
1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 103: General Physics III (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MEE 101: Introduction to Mechanical Engineering **(1 Units C: LH 15)**

Learning Outcomes:

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. identify the various branches of mechanical engineering discipline and their applications to the solution of societal problems;
3. demonstrate appreciation of the problem of climate change; and
4. demonstrate appreciation of the role of energy systems to environmental sustainability.

Course Contents

Historical development of the mechanical engineering discipline. Philosophy and scope of contemporary mechanical engineering course programme. Overview of mechanical engineering special fields: applied (solid) mechanics, fluid and thermal engineering (thermodynamics and heat transfer). Industrial/production engineering and engineering management sciences. The linkage between mechanical engineering and other engineering disciplines and the sciences. The concept of innovation. Illustrations of a wide variety applications of mechanical engineering. The role of mechanical engineers in the society and human development. Professional ethical responsibility. Climate change, renewable energy and environmental sustainability.

200 Level

GST 212: Philosophy, Logic and Human Existence **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;

2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically assess the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Learning Outcomes
Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents
Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents
Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples,

phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various pipe fittings (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system, surrounding, closed and open system, control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials **(3 Units C: LH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents
Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and

6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering **(3 Units C: LH 30; PH 45)**

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;

5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and

5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and

modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Tensor algebra and analysis, Elements of Matrices, Determinants, Inverses of Matrices, bases representation of tensors. The Euclidean point space and vector spaces. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Basic transformations: identity, spherical, Projection and Coordinate Transformation as tensors, Traces, Determinants and other scalar invariants. Equivalent stresses and strains as examples of scalar invariant. Applications to design, analyses and optimization. Elgenvalues, Elgeanvectors of tensors. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar and fiels. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications: Determinations and applications to field equations in linear abd nonlinear mechanics. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units E: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables.

Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise

analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, Poisson hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:
1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;

b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

MEE 301: Computer-Aided Design and Manufacture (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. visualise and apply basic drafting fundamentals;
2. prepare and edit engineering drawings;
3. explain the concepts and underlying theory of modelling and the usage of models in different engineering applications;
4. compare the different types of modelling techniques and explain the central role solid models play in the successful completion of CAD/CAM-based product development;
5. produce CAD drawings (create accurate and precise geometry of complex engineering systems and use the geometric models in different engineering applications);
6. use and assess commercial CAD/CAM tools efficiently, effectively and intelligently in selected engineering applications;
7. take active role in product design and development process as well as prototyping;
8. model 3D part and assemblies using SolidWorks program (or alternative CAD software);
9. analyse the part design using one of the computational methods (e.g. stress analysis) - calculate part features using math skills;
10. demonstrate proficiency in the concepts of computer-aided manufacturing and a number of applied associated processes; and
11. explain the basic concepts of CNC programming and machining.

Course Contents

Introduction to computer aided design (CAD). Basic data structuring technique. Computer graphics. Geometric transformation techniques. Mathematical bases for surface modeling: curves, surfaces and solids. Principles of solid modeling and application. CAD software. Introduction to CAM: Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems. Type of automation and benefits of soft or flexible automation. Automation in material handling and assembly. CNC machines: Introduction, classification, design and control features including interpolations. Numerical control and NC part-programming. Introduction to Robotics: Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications. Manual CNC programming (milling and turning). Basic and advanced CAD/CAM for CNC (milling and turning). Group project assignment.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;

3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MEE 401: Mechanical (Machine) Engineering Design II (3 Units C: LH 45)

Leaning Outcomes

At the end of this course, the students should be able to:
1. demonstrate proficiency in the principles of design;
2. demonstrate proficiency in the selection of materials for design;
3. carry out simple stress analysis; and
4. demonstrate proficiency in principles of coupling, clutches and brakes.

Course Contents

Journal bearings. Application of Hertz stress theory. Fluid couplings. Lubrication mechanics: hydrodynamic theory applied to tapered wedge and journal bearings and hydrostatic lubrication applied to journal bearings. Gears and power transmission systems. Elements of fluid power system design. Design of cylinders, pipes and pipe joints, tubes, plates and flywheel. Seals, packaging, gaskets and shields. Failure analysis; various types of joints, design of machine elements; system design, design of gear systems; material selection in design; design; design and production matching; optimisation in design D

MEE 402 Theory (Mechanics) of Machines II (2 Units E: LH 30)

Leaning Outcomes

At the end of this course, the students should be able to:
1. identify the forces acting on a mechanism and the resolution of the forces;
2. demonstrate understanding of the performance of various mechanisms and principal machine elements as regards their kinematics and dynamics;
3. identify the types of motion and their applications;
4. identify forces on shaft and bearing due to single revolving mass;
5. demonstrate procedure for balancing several masses in different transverse planes;
6. prepare professional quality solutions and presentations to effectively communicate the results of analysis and design;

7. translate ideas and imaginations into conceptual designs using the tools of conventional engineering drawings and computer aided designs; and
8. use the knowledge of the course to solve real life problems related to production processes and to develop machines.

Course Contents
Force analysis of mechanisms, fluctuation of kinetic energy and inertial effects. Complete static and dynamic analysis. Flexible shaft couplings: belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery. Vibration of machinery; free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts and torsional vibrations.

MEE 403: Applied Engineering Thermodynamics (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. apply the knowledge of mathematics, science and engineering fundamentals to model the energy conversion phenomenon;
2. identify fuel types, availability, utilisation and its conversion to energy, understand fuel chemistry, combustion analysis, develop combustion equations and conduct exhaust and flue gas analysis in the laboratory;
3. identify enthalpy changes, determine heating values of fuels, steam generators;
4. identify type of boilers, fuels and combustion controls in boilers and power plant efficiency;
5. perform air standard cycle analysis, refrigeration and heat pump cycles and demonstrate their various application in internal combustion engines/refrigeration systems;
6. demonstrate proficiency in energy analysis, fuel combustion and thermal systems design; and
7. provide solution to thermodynamic problems in HVAC systems, power plant, engines or renewable energy technology.

Course Contents
Multistage reciprocating compressors. Rotary compressors – centrifugal and axial-flow; stagnation properties. Simple gas turbine plant. The steam power plant. Combustion of fuels; chemistry of common hydrocarbon fuels, combustion with deficiency or excess air. Thermo-chemistry: Hess' Law of Heat Summation; heats of combustion and reaction; ideal adiabatic flame temperature. Reciprocating internal combustion engines. General thermodynamics relations. Kinetic theory of gas. Mixture of gases, psychometry, air-conditioning and cooling towers. Introduction to heat transfer.

MEE 404: Applied Fluid Mechanics (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify the various types of fluids and flows;
2. carry out simple calculations on floating and submerged surfaces;
3. explain the concept of fluid machinery for prototype development;
4. explain concepts of boundary layer;
5. explain and derive the Navier–Stokes equation for conservation of momentum and conservation of mass for Newtonian fluids;
6. describe machines that transfer energy between a rotors and a fluids;

7. identify pump types performed by simple pump selection, including both turbines and compressors; and
8. perform simple CDD grid processing, calculations and result processing.

Course Contents

Unsteady flow; oscillation in U-tube; surge tank; water hammer. Open-channel flows. Introductory concepts of boundary layer and re-circulating flows, mathematical derivation of Navier-stokes equations and its application. Dimensional analysis and similitude. Introduction to turbo machinery; characteristic curve for axial-flow and centrifugal pumps, fans, blowers, impulse and reaction turbines. Pump selection and application. Pipeline systems (Series and Parallel). Open channel flow. Overview of computational fluid dynamics (CFD)

MEE 405: Heat and Mass Transfer II (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the principle of heat by diffusion under steady or unsteady conditions;
2. explain continuity and momentum equations and their roles in convection heat transfer analysis;
3. recognise convection heat transfer in laminar and turbulent flows;
4. determine heat transfer coefficients in internal and external flows;
5. identify dimensionless groups in convection heat transfer;
6. identify combined modes of heat transfer;
7. perform simple heat exchanger analysis and design;
8. demonstrate an understanding of heat and mass transfer modes and models;
9. demonstrate understanding of the different types of interface reactions;
10. explain comparison of Fick's and Fourier's laws and similarities between conduction and mass transfer in stationary systems; and
11. apply principles of heat and mass transfer phenomena to selected processes.

Course Contents

Convection heat transfer: Newton's law of cooling. Energy equation of convection. Continuity and momentum equations and their roles in convection heat transfer analysis. Convection heat transfer in laminar and turbulent flows. Internal and external flows. Heat transfer coefficients. Dimensional analysis and dimensionless groups in convection heat transfer. Convection heat transfer correlations. Heat exchanger analysis and design. Combined modes of heat transfer.

Mass transfer: Mechanisms of mass transfer. Fick's law of mass diffusion. General diffusion law. Rate equations. Comparison of Fick's and Fourier's laws. Equations of mass transfer in stationary systems. Similarities between conduction and mass transfer in stationary systems. Mass transfer coefficient. Electrical analogy of mass transfer. Equimolal counter diffusion. Drying and humidification of solids and gases. Types of dryers. Evaporation. Mass transfer correlations in convective systems.

MEE 406: Advanced Mechanics of Materials (2 Units C:LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the theory, concepts, principles and governing equations of solid mechanics;
2. demonstrate the ability to deconstruct complex problems to produce effective outcomes;

3. perform simple analysis on thick cylinders; compound cylinders, rotating disks and bending of flat plates;
4. perform simple analysis on beams on an elastic foundation;
5. explain two-dimensional theory of elasticity and apply to elastoplastic problems;
6. use analytical, experimental and computational tools needed to solve the idealised problem;
7. Use these solutions to guide a corresponding design, manufacture, or failure analysis;
8. explain the selection, design and stress analysis of composite materials;
9. analyse the stresses in simple structures as used in industry, and
10. use interpersonal understanding, teamwork and communication skills working on group assignments.

Course Contents

Thick cylinders; compound cylinders. Rotating disks. Bending of flat plates. Beams on an elastic foundation. Membrane stresses in shells of revolution. Two-dimensional theory of elasticity. Elastoplastic problems and limit theory.

500 level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MEE 503: Applied Design (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate proficiency in systematic scientific design methodology;
2. demonstrate creative application of the design process to engineering problems;
3. demonstrate proficiency in design for the manufacture of complete mechanical systems and devices;
4. undertake a group design project;
5. submit reports showing all calculations, justification for choice of design and instructions on detail design, manufacture, testing and use; and
6. demonstrate use and evaluation of a CAD/CAM software package in the actual manufacturing design project.

Course Contents

Scientific Design Methodology: creative application of the design process to engineering problems with emphasis on the manufacture of complete systems to accomplish overall objectives of minimum weight, high efficiency while satisfying the design constraints. An appreciation of the process of engineering design, and of systematic procedures and tools usable in the design process, with particular reference to mechanical systems and devices. Topics include systematic problem definition, search for possible solutions, statistical analysis of stress/strength interference, experiment planning techniques, optimum design for minimum weight and cost, and management of the design process. Design Project: Students will be required to conduct a design project under supervision, using the presented techniques, and taking at least to a workable layout drawing of a device. The design should involve simple mechanical systems (e.g. testing and assembling devices, heat drive, etc.) for a specified duty, analyse its operating conditions and after considering the design criteria, choose between potential solutions. Reports submitted by students should contain all calculations, a comparison of potential solutions, justification for the design finally chosen, and instructions on detail design, manufacture, testing and use. Use and evaluation of several CAD/CAM software packages. Students will gain experience with CAD/CAM software while carrying out an actual manufacturing design project.

MEE 509: Project **(6 Units C:L H/PH 270)**

Learning Outcomes

At the end of this course, the students should be able to:

1. identify an engineering research problem;
2. demonstrate proficiency in PowerPoint presentation in a seminar;
3. demonstrate a methodology for actualising aims and objectives of a research project;
4. partake in a group research project efficiently; and
5. submit report comprising a topic, abstract, problem statement, aims and objectives, methodology, experimentation and/or analysis, results and analysis, conclusion and recommendation.

Course Contents

Final-year projects are assigned at the beginning of each academic year. Each final year student chooses a project supervisor in consultation with the final-year project coordinator. The process is entirely interactive, but the coordinator ensures that there is an even distribution of students amongst the lecturers. The final topic is decided by the student and his supervisor, selected from the fields of mechanics of solids and fluids, materials science, machine design, heat power, heat transfer, production technology, industrial engineering and management. Each student presents at least two seminars as part of their final year project, usually at the beginning and ending of the second semester. Each student is required to submit a report of their findings and undergo an oral examination. All seminars are scored by a panel of lecturers.

Minimum Academic Standards

Equipment

Common Facilities

1. University Libraries
2. Lecture Theatres and Lecture Rooms
3. Laboratories/ Central Workshops
4. Drawing Studio
5. Computer-Aided Graphics Laboratory
6. Faculty Computer Laboratory
7. Industrial Training Coordinator's Office.
8. Laboratories for Some General Engineering Courses

Laboratories/Workshops

General Workshop
Drawing and Design Studio
Mechanics of Machines
Strength of Materials
Thermodynamics
Fluid Mechanics
Metallurgy

General Workshop Equipment

Fitting & Machining Section

1. Work benches with vices for metal work
2. Tool boxes containing hand tools such as screw drivers, wrenches, hammers, hacksaws, files, centre punch, chisel, scrapers, etc.
3. Lathe machines
4. CNC lathe machine
5. Milling machines
6. CNC milling machine
7. Drilling machines
8. Grinding machines
9. Folding machines
10. Power hacksaw
11. Shaping machines
12. Tennoning machine
13. Vertical mortising machine
14. Dovetailing machine
15. Vernier Callipers and Micrometer Screw Gauges
16. Sheet metal folding machine

Foundry Section

1. Furnaces (heat treatment facility)
2. Casting facilities

Welding & Fabrication Section

1. Arc welding machines and accessories
2. Gas welding facilities
3. Safety goggles, eye and ear protectors
4. Pop riveting machine
5. Guillotine cutting Machine
6. Rolling machine, etc.
7. Spot welding machines

Carpentry & Woodwork Section (Wood processing machines and equipment)

1. Band saw, radial arm saw and circular saw
2. Surfacing machine
3. Mortise machine
4. Thicknessing/Planing machine
5. Wood Lathe machine
6. Portable sander machine
7. Jig saw, rip saw, cross-cut saw, panel saw, tenon saw, compass saw
8. Drilling machine
9. Chest drill
10. Spraying machine
11. Oil stone
12. Wood workbenches with vices
13. G clamp, F clamp, Sash clamp
14. Jack planes, smooth planes

15. Other hand tools such as tri square, claw hammer, pincer, marking gauge, mortise gauge, spirit level, flat chisel, wood rasp, round chisel, wood mallet, spoke shave, screw drivers, tape rule, scraper.

Electrical/Electronic Section

1. Water distillers
2. Hydrometers
3. Multimeters, voltmeters, ammeters and clamp meters
4. Soldering irons
5. Battery chargers
6. Standard tool boxes for electrical and electronics works
7. Electrical/electronics data books
8. Oscilloscopes
9. Tachometers and phase sequence meters
10. Logic probes
11. Etching machines complete with accessories
12. Coil winding machine, etc.

Drawing and Design Studio

1. Drawing tables and chairs
2. Drawing boards, T-squares and instruments
3. Automatic drafting machine
4. Drafting gadgets, stencils, etc
5. Automatic stencil cutter
6. Computer graphics and design hall with necessary design software (e.g. Fusion 360 (AutoCAD) software, SolidWorks**,** Solid Edge or equivalent
7. 3-D printer

Mechanics of Machines Laboratory

1. Free oscillation of point and distributed masses (Simple and Compound Pendulum)
2. Quick return mechanisms (Whitworth), Scotted line slider-crank, scoth yoke Geneva stop
3. Power transmission systems (belts, gears, shafts and clutches).
4. Coefficient of friction apparatus (belt, drive, slipping friction)
5. Free and force vibration of single degree of freedom systems with and without damping
6. Static and dynamic balancing systems
7. Power regulation (by Flywheel and Governors)
8. Demonstration of coriolis and centrifugal forces
9. Gyroscopic motion
10. Journal bearings
11. Vibration and Noise test set up.

Strength of Materials Laboratory

1. Apparatus for tensile, compression and torsion tests
2. Simple bending apparatus
3. Unsymmetrical bending apparatus
4. Impact tests apparatus
5. Elastic behaviour of thin- and thick-walled pressure vessels
6. Creep and fatigue
7. Theories of failure
8. Helical springs
9. Deflection of curved beams
10. Columns and struts
11. Strain gauging and photo-elastic behaviour.

Thermodynamics Laboratory

1. Temperature measurement apparatus
2. Power measurement apparatus (compressor, dynamometer etc)
3. Pressure measurement apparatus
4. Steam boiler
5. Equilibrium of mixtures of air and steam, quality of wet steam
6. IC engine apparatus
7. Calorific values of fuels
8. Analysis of products of combustion
9. Gas and bomb calorimeters
10. Gas and steam turbine apparatus
11. Heat-exchange apparatus
12. Free and forced convection heat and mass transfer systems
13. Thermal conductivity apparatus
14. Apparatus for the determination of radiative properties of materials
15. Jet propulsion systems
16. Vapour power cycles
17. Positive displacement engines and compressors
18. Refrigeration and Air-conditioning cycles

Fluid Mechanics Laboratory

1. Manometry
2. Hydrostatic forces on plane and curved surfaces
3. Forced vortex apparatus
4. Stability of floating bodies
5. Meter calibration and flow test set up
6. Hydraulic test benches
7. Nozzle and orifice flow apparatus
8. Laminar and turbulent flow in pipes
9. Friction loss in pipes
10. Heat losses in pipe fittings
11. Flow visualisation apparatus
12. Flow of fluid round bodies
13. Hydraulic power circuitry and measurement units
14. Reciprocating pump system
15. Centrifugal pump system
16. Pelton wheel
17. Resistance to motion of air through banks of finned and unfinned tubes
18. Calibration and performance of flow measurement devices
19. Subsonic wind tunnel and accessories
20. Supersonic flow apparatus

Metallurgy Laboratory

1. Apparatus for visualisation of atomic and crystal structures
2. Cooling curve apparatus
3. Simple metallography
4. Simple heat treatment apparatus
5. Apparatus for creep, hardness and fracture tests
6. X-ray crystallography equipment

7. Electric microscope
8. High power metallurgical microscope with camera unit

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

library

Subject to the general standards specified by NUC, the central and/or faculty/departmental libraries should have:

1. physical holdings of current books in the relevant fundamental science and engineering subject areas;
2. physical holdings of current books in the core mechanical engineering subject areas;
3. physical holdings of current journals in the core mechanical engineering subject areas;
4. e-subscription of current books in the relevant fundamental science and engineering subject areas;
5. e-subscription of current books in the core mechanical engineering subject areas; and
6. e-subscription of current journals in the core mechanical engineering subject areas.

classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Mechatronics Engineering

Overview

Mechatronics Engineering is a branch of engineering that deals with developing products, systems and processes that involve a synergistic integration of aspects of mechanical (such as hydraulics and pneumatics), electronic (as in sensors and communication) and electrical engineering (control), computing, robotics, and information technology. Application areas of mechatronics include such diverse fields as in medical and agricultural equipment, military hardware, oil and gas, automobile, home and industrial automation, etc. The multidisciplinary nature of mechatronics entails design principles, processes, models, toolsets and philosophy that are unique to mechatronics engineers. This enables the design and development of simpler, more economical and reliable systemsMechatronics ensures the production of high-quality systems and equipment with high precision and accuracy and improved production processes through automation. Due to their multidisciplinary skills, mechatronics engineers are on high demand worldwide. Topics covered include mechanism design, motor and sensor integration and theory, microcontroller programming using numerous sensors and actuators, mechanics prototyping, and design. Students will work in teams to complete a hardware-based final project.

The programme has a unique balance of critical analytical subjects and professional skills, which enables students to graduate with the confidence to face challenging engineering situations in the industry. The management skills necessary to operate successfully as a multidisciplinary engineer in modern industry are promoted and developed at all the stages of the course.

Philosophy

The general philosophy of the Mechatronics Engineering programme is to produce graduates with high academic and soft skills competence, which can adequately participate, transform, impact on the engineering and allied industries in accordance with National and Global community values, including National Policy on Industrialisation and Self-Reliance. Hence, the programme aims to produce graduates with sufficient academic background and adequate practical experience to solve engineering problems.

Objectives

The prgramme's overall objective is to provide students with relevant skills in designing and prototyping of mechatronic or robotic system to accomplish specific tasks or challenge. On completion of the programme, successful students should be able to:

1. demonstrate systematic knowledge and understanding of essential facts, concepts, theories and principles of mechatronics engineering and of the broader multidisciplinary engineering context and its underpinning science and mathematics;
2. apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the Mechatronics Engineering-related problems;
3. demonstrate practical engineering skills in the design and development of mechatronics products;
4. demonstrate the ability to apply appropriate quantitative science and engineering tools to analysing problems;
5. demonstrate creative/innovative ability in the synthesis of solutions and in formulating designs;

6. demonstrate an understanding of different roles within a team and to exercise leadership;
7. display well-developed critical thinking capabilities, including analysing, evaluating and critically reflecting on information, decisions and behaviour to enable strategic thinking and adaptability in a constantly changing global environment;
8. create, select and apply appropriate techniques, resources and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, to understand their limitations;
9. apply independent learning skills that encourage the regular accessing of new knowledge and information;
10. use effective written communication and well-developed interpersonal skills;
11. design, specify, plan, organise, and implement a mechatronics system;
12. compare, contrast and evaluate alternative approaches to mechatronics system designs.
13. plan the extension and upgrading of the existing mechatronics system effectively.
14. demonstrate a critical awareness and evaluation of current research within engineering;
15. develop entrepreneurial skills and adequate training in human and organisational skills with a spirit of self-reliance to set up their businesses; and
16. possess the appropriate skills and knowledge to pursue further study and professional development opportunities.

Unique Features of the Programme

Some unique features of the programme include:
1. stimulating intellect and encouraging students towards developing ingenuity and originality in problem solving;
2. encouraging students to maintain intellectual curiosity that will motivate them to pursue meaningful lifelong learning; and
3. equiping students with the relevant intellectual capacity, contemporary software proficiency, communication, entrepreneurial and
4. other relevant soft skills like teamwork, flexibility, adaptability and interpersonal knack to engage effectively in engineering practice, business and in leadership roles

Employability Skills

Mechatronics engineers work in companies and firms that require hi-tech input into what they are developing. They may work in a laboratory, a processing plant or an engineering office and research opportunities in emerging fields like bioengineering, nanotechnology, and robotics. Typical job responsibilities of mechatronic engineers are:

1. developing new solutions to industrial problems using mechanical and electronic processes and computer technology;
2. design and building entirely new products by integrating various technologies, for example, developing robotic vehicles for underwater exploration;
3. building and testing factory production lines by introducing automation to improve existing processes;
4. maintaining and improving on previous industrial and manufacturing processes and designs, for example, robotic lawnmowers and robot floor cleaners;
5. designing, developing, maintaining and managing high technology engineering systems for the automation of industrial tasks;
6. applying mechatronics or automated solutions to the transfer of material, components or finished goods;
7. applying advanced control systems, which are usually computer-driven;
8. apply electronics and mechanical processes and computers to tasks where the use of human labour may be dangerous (like underwater exploration, mining or forestry);

9. studying the feasibility, cost implications and performance benefits of new mechatronics equipment; and
10. carrying out the modelling, simulation, and analysis of complex mechanical, electronic or other engineering systems using computers.

21st Century Skills

The programme has emphasised 21st-century skills -- problem-solving, collaboration (teamwork), digital literacy, communication, learning to learn/metacognition, creativity and innovation, information literacy, critical thinking/decision making, artificial intelligence (AI) through collaborative research projects and group assignments.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:
1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes which must include English Language, Mathematics, Physics and Chemistry, candidates with at least two passes in relevant subjects (Mathematics, Physics and Chemistry) at the GCE Advanced Level or IJMB or JUPEB may be considered for admission. Candidates who have good National Diploma (ND) result in relevant Engineering Technology programmes may also be considered for admission into 200 level. Holders of upper credit pass and above at Higher National Diploma (HND) level, are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.

5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Discipline/ GET	Programme (MCE)	SIWES*	Total Units
100	4	16	3	2	-	25
200	4	-	29	-	3	33
300	4	-	18	2	4	28
400	-	-	-	10	8	08
500	-	-	5	8	-	11
Total	**12**	**16**	**55**	**22**	**(15)**	**105**

*All 15 SIWES units credited in the 2nd Semester of 400-level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 113	Nigerian Peoples and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics & Solid Modelling	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	45	-
PHY 102	General Physics II	2	C	45	-
PHY 107	General Practical Physics I	1	C	-	45
PYH 108	General Practical Physics II	1	C	-	45
MCE 101	Introduction to Mechatronics Engineering	2	C	30	-
	Total	**25**	C		

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	E	45	-
GET 203	Engineering Graphics & Solid Modelling II	3	C	15	45
GET 204	Students Workshop Practice	2	C	45	-
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
MEE 207	Applied Mechanics	3	C	45	-
*GET 299	SIWES	3	C	9 Weeks	
	Total	**30**			

300 Level

Course Code	Course Titb	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	45	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	30	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication (including Seminar Presentation Skills)	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
MCE 321	Design of Mechatronics and Robotics Systems I	2	C	30	-
*GET 399	SIWES II	4	C	12 Weeks	
	Total	**24**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
MCE 401	Computer Vision and Image Processing	2	E	30	-
MCE 403	Microcontroller and Embedded Systems	2	E	30	-
MCE 405	Control Engineering	2	E	15	45
MCE 407	Industrial Automation & Control	2	E	30	-
MCE 409	Sensors and Actuators	2	E	30	-
GET 499	SIWES III	8	C	24 wks	

	Total	**0**			

***SIWES courses**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I: SWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III	8	C	24 weeks
	Total	**15***		

* All credited at the 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MCE 501	Design of Mechatronics and Robotics Systems II	2	E	-	90
MCE 590	BEng Project	6	C	-	270
	Total	**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice.

Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take;and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work,

potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MCE 101: Introduction to Mechatronics Engineering
(2 Units C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the characteristics and components of mechatronics systems;
2. discuss recent trends in Mechatronics;
3. describe the techniques used in designing a mechatronics process;
4. identify, select, and integrate mechatronics components to meet product requirements; and
5. develop kinematic, dynamic and control models for robots.

Course Contents

Introduction to mechatronics systems -- Measurement Systems, Control Systems, Microprocessor-based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Level. Temperature, Light Sensors – Selection of Sensors. Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – DC Motors – AC Motors – Stepper Motors. Introduction to Robot and Robotics, Three laws of robotics, History, Issues of industrial robot usage, Robot Types, limitations, Architecture and Configuration of Robots, Applications of Robots, Robots Classification, Robot Repeatability and Accuracy, Robot component, Degree of freedom, Drive Technologies, Coordinate Systems, three related frames, Rotational about fixed frames (x,y,z). Transformation of Coordinate Frame, Forward Kinematics, Orientations, Translation of rigid body. Introduction to robotics, mobile robots, swamp robot and industrial robots, Robot Mechanisms, Actuators and Drive Systems, Differential Motion, Statics and dynamics, Force and Compliance Controls, Realistic and Safe Use of Robots.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30, PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which

enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents
Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)

Learning Outcomes
Students should be able to:
1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs;
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs;
3. be able to analyze and optimize designs on the basis of strength and material minimization;
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate; and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing.

Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-v-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 207: Applied Mechanics (3 Units C: LH 45)

Learning Outcomes

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum.
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics.

3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load.
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc. as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;

5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;

4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:
1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;

5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

MCE 321: Design of Mechatronics and Robotics Systems I
(2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to developed the following skills:
1. ability to utilise a systems approach to complex problems and to design an operational performance;
2. proficiency in engineering design;
3. capacity for creativity and innovation;
4. ability to function effectively as an individual and in multidisciplinary and multicultural teams, as a team leader or manager as well as an effective team member; and
5. ability to apply systems engineering perspective in designing mechatronics systems.

Course Contents

Integrated design process of mechatronics systems; components of mechatronics systems, sensors and actuators, fundamental principal of operation for components, strengths and weaknesses, and operational characteristics. The design process; integrated iterative design, sub-systems, component selection and sizing, design considerations, state-of-the-arts and challenges. Design exercises with increasing degrees of complexity. Others are mechatronics design concepts: integrative design, concepts analogies between electrical and mechanical systems, appreciation of components of mechatronics systems, formulation of design requirements, design exercise and justifications, optimal division into sub systems component, selection and sizing prototype development, appraisal of benefit and cost evolution of mechatronics design and challenges. case studies.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;

3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

400 Level

MCE 401: Computer Vision and Image Processing (2 Units E: PH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the basic algorithms, tools and systems for the management, processing and analysis of digital images;
2. identify basic concepts, terminology, theories, models and methods in the field of computer vision;
3. describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition;
4. assess which methods to use for solving a given problem, and analyse the accuracy of the methods;
5. develop and apply computer vision techniques for solving practical problems;
6. choose appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation;l
7. acquire good and practical skills in computer vision; and
8. design and develop simple systems oriented to real-world computer vision applications such as those requiring segmentation and classification of objects in digital images.

Course Contents

Computer vision and image processing are important and fast evolving areas of Mechatronics and Robotics. Student will get familiar with both established and emergent methods, algorithms and architectures. The course will enable students to apply computer vision and image processing techniques to solving various real-world mechatronics and robotics problems, and develop skills for research in the fields. Image formation, image filtering, edge detection and segmentation, morphological processing, registration, object recognition, object detection and tracking 3D vision.

The topics may include but are not limited to:

1. Image formation and perception, image representation.
2. Image filtering: space- and frequency- domain filtering, linear and non-linear filters.
3. Morphological image processing.
4. Image geometric transformations, image registration.
5. Edge detection, image segmentation, active contours, and level set methods.
6. Object recognition, template matching, and classification.
7. Object detection and tracking: background modeling, kernel-based tracking, particle filters.
8. Camera models, stereo vision.

MCE 403: Microcontroller and Embedded Systems (2 Units E: PH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. provide examples of existing embedded systems-based products and describe the special requirements placed in developing such systems;
2. use modern integrated development environments for microcontroller/processor programming and their features for testing and debugging;
3. develop microcontroller programs for mechatronic applications, including the usage of I/O and communication peripherals;

4. describe, explain, and apply some of the basic concepts of communication protocols, particularly the Controller Area Network (CAN);
5. explain basic real-time resource management theory;
6. discuss and communicate intelligently about OS primitives for concurrency, timeouts, scheduling, communication, and synchronisation; and
7. discuss I/O and device driver interfaces to embedded processors with networks, multimedia cards, and disk drives.

Course Contents

Introduction to embedded systems, history, design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols like SPI, I2C, CAN etc. RISC Design Philosophy, comparison between CISC and RISC; PIC/AVR/ARM Design Philosophy; Embedded System hardware, Embedded System software. PIC/AVR/ARM Processor fundamentals – PIC/AVR/ARM core architecture, data flow model, Register, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, PIC/AVR/ARM Processor families. PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 processors Block diagram and pin diagram, operating modes: Study of on-chip peripherals like I/O ports, timers, counters, interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM and USB. Hardware interfacing of PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 using CCS C Compiler/Flowcode/Embedded C language: LED, Switches, LCD Display & stepper motor. On-chip programming: UART, Timer, Real-Time Clock & ADC. Others include Architecture of kernel, task and task scheduler, ISR, Mutex, Semaphores, mailbox, message queues, pipes, events, timers, Priority inversion problem, priority Inheritance, RTOS services in contrast with traditional OS. Introduction to µcos II RTOS and its features, study of kernel structure of µcos II. Case study of digital camera and automatic chocolate vending machine (without codes).

MCE 405: Control Engineering (2 Units E: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. develop the mathematical model of the physical systems;
2. analyse the response of the closed and open loop systems;
3. analyse the stability of the closed and open loop systems;
4. design the various kinds of compensator;
5. explain alternate representations of dynamic systems (time domain, frequency domain, state space);
6. define and explain feedback and feed-forward control architecture and discuss the importance of performance, robustness and stability in control design;
7. interpret and apply block diagram representations of control systems and design PID controllers based on empirical tuning rules;
8. compute stability of linear systems using the Routh array test and use this to generate control design constraints;
9. employ Evans root locus techniques in control design for real world systems;
10. compute gain and phase margins from Bode diagrams and Nyquist plots and understand their implications in terms of robust stability;
11. design Lead-Lag compensators based on frequency data for an open-loop linear system;
12. analyse the stability of systems by root locus and frequency response methods;

13. draw Bode diagrams, root locus graphs and Nyquist plots for the analysis of control systems solve numerical problems on control systems; and
14. utilise MATLAB/Simulink to analyse open and closed loop performance and design linear feedback controllers.

Course Contents

Introduction to control system: Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function. Mathematical modelling of dynamic systems: Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring– MassDashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tachogenerators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.

Time domain analysis: Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh Hurwitz criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants. **Stability Analysis:** Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichol's chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichol's chart. circle and Contours in Nichols chart. **Control System performance measures:** Improvement of system performance through compensation. Lead, Lag and Lea lag compensation, PI, PD and PID control.

MCE 407: Industrial Automation and Control (2 Units E: PH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe working of various blocks of basic industrial automation systems;
2. demonstrate proficiency in automation programming/troubleshooting related to programmable logic controllers;
3. connect the peripherals with the PLC.
4. utilise various PLC functions and develop small PLC programs;
5. Summarize distributed control system and SCADA system;
6. demonstrate an understanding of the core hardware and theory related to programmable automation controllers;
7. employ various industrial motor drives for the Industrial Automation; and
8. design, install and maintain automation and control systems.

Course Contents

This course will provide an overall exposure to the Technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course covers a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC machines. More specifically, the course covers:

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems **Measurement Systems:** Pressure and Force Measurement, Temperature measurement, Displacement and Speed Measurement, Flow Measurement, Measurement of Level, Humidity and pH, Signal Conditioning Circuits, Errors and Calibrations. **Process Control:** Introduction to Process Control, PID, PID Controller Tuning, PID Controller Implementation **Programmable Logic Control:** The Software Environment and Programming of PLC, Sequence Control and Structured RLL Programming, Programming of PLCs Sequential Function Chart. **CNC Machines:** Introduction to CNC Machines, CNC Machines Interpolation, Control and Drive. **Actuators:** Control Valves, Directional Control Valves, Switches and Gauges, Industrial Hydraulic Circuits, Pneumatic Control Components, Pneumatic Control Systems,
Electric Machines Drive: Energy Savings with Variable Speed Drives, Step Motors - Principles, Construction and Drives, DC Motors Drives, Induction Motor Drives, BLDC Motor Drives. **Industrial Embedded and Communication System:** Introduction to Real-time Embedded Systems, Real-Time Operating Systems, Networking of Field Devices via Fieldbus, Higher Levels of Industrial Automation.

MCE 409: Sensor and Actuators **(2 Units E: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. itemise and discuss the characteristics and the components of mechatronic systems;
2. discuss recent trends in Mechatronics;
3. describe active & passive electrical circuits;
4. describe the techniques used to design a mechatronics process; and
5. suggest possible design solutions.

Course Contents
This course provides an introduction to sensors and actuators in mechatronics systems. The topics include sensing principles for measuring motion, force, torque, pressure, flow, and temperature using analogue and digital transducers; actuating principles for continuous drive actuators and stepper motors; power transmission systems; and methods for signal collection, conditioning and analysis. Various components will be experimentally tested and analysed. Others are basics of Energy Transformation: Transducers, Sensors and Actuators.
Understanding of Sensor Interfacing with Microprocessor to build electronic system Week Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor-based electronics systems. Sensor performance criteria and selection, including: (a) Thermocouples (b) Resistive sensors (c) Inductive sensors (d) Capacitive sensors (e) Piezoelectric sensors (f) Encoders and tachometers. Actuator performance criteria and selection, including: (a) Fluidic actuators (b) Solenoids and voice coil motors (c) Stepper motors (d) DC motors (e) Piezoelectric actuators (f) Shape memory alloy actuators (g) MEMS sensors and actuators. Merits of Fluid power & its utility for increasing productivity through Low-Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, Signalling & control system. Introduction to Industrial Hydraulics, Hydraulics Power System elements and standard symbolic

Representation (CETOP symbols). Pneumatic & hydraulic control elements (control valves & hydraulic pumps, accessories), Basic circuits for controlling single & double-acting cylinder, Basic circuits, Advantages of Hydro-Pneumatics and its applications, Hydraulics system and their Classification. Hydraulics circuits Hydraulic Motors, Hydraulic Fluids and effective contamination control. Advanced pneumatic circuits for controlling multi-cylinders (operable & inoperable circuits), Electro pneumatics with relay logic, Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and

5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MCE 501: Design of Mechatronics and Robotics Systems II
(2 Units C: PH 90)

Learning Outcomes
At the end of this course, the students should be able to develop the following skills:
1. ability to practicalise the systems approach to complex problems learned MCE 321;
2. practicalise the design of an assigned device for operational performance;
3. dexterity in engineering design and implementation;
4. evaluation of designed mechantronic systems; and
5. ability to partake in design and innovation competitions.

Course Contents
This is essentially the practical implementation of the content of MCE 321, with students working independently and in focus groups. See content of MCE 321 for more details.

MCE 599: Final Year Project **(6 Units C: LH 270)**

Learning Outcomes
At the end of this course, the students should be able to:
1. prepare for real-life postgraduation experience in project implementation and report writing skills. The course lasts for one academic session.

Course Contents
Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars. This course lasts for one academic session.

Minimum Academic Standards

Equipment
List of Laboratories
1. Control and Instrumentation Laboratory
2. Electronics Laboratory
3. Microcontroller/Microprocessor and Digital System Laboratory
4. Computer Engineering Laboratory (Hardware and Software)
5. Communication Laboratory
6. Energy Laboratory
7. Electric Power/Machine Laboratory

List of laboratory Equipment
1. Assorted Microcontroller/Microprocessor developments Kit
2. Assorted sensors and Actuators Units
3. Didactic Electro Hydraulic Trainer
4. XK-CF2 Mechatronic Training Equipment Material Sorting Model
5. PLC Training Kit XK-PLCS1
6. Automatic Storage and Retrieval System
7. DLDS-1508 Robot Training System
8. Mechatronics Training Assessment Equipment
9. Position Control Trainer Mechatronics
10. Optical and Electromechanical Technology Trainer
11. Micro Mechatronic System Training Equipment

12. Mechatronics Automation Production Line Training Equipment
13. Process Control Training Equipment
14. Robot Teaching Equipment
15. Assorted Sensors, Actuators and Controllers
16. Design Software Packages (Matlab, SolidWorks, LabView, Ansys, PRoE
17. CAD/CAM Machines (CNC mill, drill, lathe, 3D printer, laser cutter)
18. Digital Logic Aanalyser
19. Smart Logic Design Experimental Kit
20. Digital Logic Circuit Design Experiment Kit Microcomputer Trainer
21. AM/FM Transmitters and Receivers System Trainer
22. Fibre-optic Transmission Training System
23. GSM/GPS Experimental Trainer
24. Programmable Logic Controller System Trainer
25. Digital 3 Phase Power Analyzer with SD Card Real Time Data Recorder
26. Digital Storage Colour Display 2/4-Channel Oscilloscope
27. Arbitrary Waveform and Digital Synthesized Function Generator
28. Digital Spectrum Analyzer (9kHz -3GHz)
29. Instrumentation Trainer Using Transducers Complete Set
30. Digital Communication System Trainer
31. Analog Communication System Trainer
32. Solar Power System Training Kit
33. Electrical and Electronic System Trainer
34. Single Phase Transformer System Trainer
35. 3- Phase Transformer System Trainer
36. Power Electronic Training System
37. Colour TV Trainer
38. Programmable Dual Output DC Power Supply Units (different ranges)
39. Variable Transformer
40. PA (Public Address) System Trainer
41. Portable Wind Power Generator Training Kit Universal EPROM Programmable (48 Pins)
42. Bench Digital Multi-meter Digit (various digit ranges)
43. High Voltage Insulation Tester Variable Digital Type up l0kV Power Factor Meter
44. Frequency Meter
45. Digital Energy Meter
46. Digital Wattmeter, Single Phase
47. Digital Wattmeter, 3-Phase
48. Semiconductor Curve Tracer
49. Advanced Frequency Modulation and Demodulation Train
50. Digital Transistor Tester
51. Decade Resistance Box
52. Decade Capacitance Box
53. Decade Inductance Box
54. 3-Phase Variable Inductance Load
55. 3-Phase Variable Capacitance Load
56. 3-Phase Variable Resistance Load
57. Digital Multifunction Documenting Calibrators
58. Digital Function generator (different frequency ranges)
59. Electrical Tools Box
60. Digital Stroboscope
61. Digital DC A Ammeters Multi-range
62. Digital AC Voltmeters Multi Range
63. Digital DC Volt Meters Multi Range

64. Digital DC Volt Meters Multi Range
65. Digital Damp Meter
66. Standard Digital Earth Loop/PSC/Tester
67. Photo/contact Tachometer
68. LCD Display 3-Phase Rotation Tester
69. Rheostat (different ranges)
70. Wheatstone Bridge
71. Portable DC Potentiometer
72. Analogue Dual-trace Oscilloscopes (different frequency ranges)
73. Signal Trace/Injector
74. Digital RF Signal Generators
75. Klystron Microwave Trainer Complete Set
76. Antenna Lab Trainer complete Set
77. PCB Fabrication Equipment Complete Set
78. Standard Analogue Multimeters
79. AVO Meters
80. Electric Power Transmission Training Kit

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.
NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

library

subject to the general standards specified by NUC, the central and/or faculty/departmental libraries should have:

1. physical holdings of current books in the relevant fundamental science and engineering subject areas.
2. physical holdings of current books in the core mechanical engineering subject areas.
3. physical holdings of current journals in the core mechanical engineering subject areas.

a. e-subscription of current books in the relevant fundamental science and engineering subject areas.
b. e-subscription of current books in the core mechanical engineering subject areas.
c. e-subscription of current journals in the core mechatronics engineering subject areas.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Metallurgical Engineering

Overview

"Only the resource of man can bring the resource of the earth to life."- Paul Baily.

When considering the Techno-economic Importance of Metals, Globally, one can assert boldly that "Without metals, there will be no civilisation". The wellbeing and standard of living of any nation can be accurately gauged by reference to the level of production and/or consumption of its metal and metal products. Techno-economic development of any nation depends considerably on the level of its industrial development.
Also, "We can only chart our future clearly and wisely only when we know the path which has led to the present"- Adlai Stevenson. The Nigeria metals industry can be logically divided into two subsections: the Nigerian Public Metals Industry and the Nigerian Private Metals Industry and the industry can also be classified into two: ferrous (Iron and steel) metal industry and non-ferrous (such as gold, aluminium, tin, lead and zinc) metals industry. The non-ferrous metals industry started before the iron and steel industry in Nigeria.
The development of the metallurgical sector in Nigeria was a major thrust for the establishment of departments of metallurgical and materials engineering at some Nigerian universities, starting with the University of Ife (now Obafemi Awolowo University), Ile-Ife, in 1977. The goal was to produce world-class, well trained and adequately equipped metallurgical, minerals and materials engineers for the Nigerian metallurgical industry, especially in the Iron and Steel sector of the economy.

Metallurgical engineering is concerned with the extraction, refining and recycling of metals and/or alloys, and preparing them for use. It is broader than metallurgy which is the art and science of producing metal and alloys in forms and with properties suitable for practical use in that equipment/plant design, energy transfer, materials processing and selection, and mathematical analysis such as simulation and modelling of metallurgical systems are encapsulated by metallurgical engineering. It focuses on the engineering aspect of metals such as reductions to prevention of corrosion in application, increasing the strength of alloys and developing alloys with improved properties for use by the household, transportation - road, railway, aerospace and shipping-industry, medical industry, production and defence industries. The main branches of metallurgical industries are process (extractive), physical and production (mechanical) metallurgical engineering. The need to revive industries and set factories working in Nigeria presents an exciting challenge to the Nigerian metallurgical engineers.

In Nigeria the main mining leases are classified in accordance to the type and nature of occurrence as follows:
Class A: Metalliferrous minerals and precious metals lode leases
Class B: Metalliferrous minerals and precious metals alluvial leases
Class C: Precious stone (gemstone) leases
Class D: Combustible (carbonaceous) mineral leases
Class E: Non-metallic (industrial) mineral leases
All the five (5) categories of mineral leases are available in Nigeria, so the nation is a mineralised nation. In spite of this, the Nigerian metallurgical industry has neither been able to produce on sustainable basis ferrous (iron and steel) nor non-ferrous metals (such as gold, aluminium, lead, copper, zinc) whose ores are available in the nation. This scenario has to be reversed through qualitative metallurgical engineering education, linkages and collaboration with ministries, agencies and departments on one hand and mineral and metallurgical industries on the other hand.

Philosophy

The philosophy for Metallurgical Engineering programme therefore, is geared to be sufficiently robust to engender and employ a curriculum that is adequate in concept, content and context for training and equipping Nigerian engineering students in the 21st Century who upon graduation will be self-reliant, nationally relevant and globally competitive in industry, academia, government and society at large.

Objectives

Stemming from the philosophy, the main objective of the Metallurgical Engineering programme is to engender value driven synergy for techno-economic, safe, environmentally friendly extraction and refining of metals and/or alloys from their ores and preparing them for use. The specific objectives of Metallurgical Engineering degree programme include the following:

1. Bring about revival and sustenance of Nigerian Metallurgical Industry (ferrous and non-ferrous) particularly Ajaokuta Steel Complex and associated steel companies, and Aluminium Smelting Company for rapid national industrialisation in line with the local content development policy.
2. engender sustainable development and value addition chain to the Nigerian minerals, ferrous and non-ferrous, for national technological and socio-economic development.
3. produce technically competent, self-reliant and entrepreneurial graduates who in a collegiate spirit are capable of being employers of labour in various aspects of metallurgical industry such as welding, foundry, industrial finishing, corrosion prevention/electroplating, alloying, heat treatment and metal working processes such as rolling, forging, extrusion, wire/rod drawing and deep drawing, and forensic engineering services.
4. produce technically competent and academically sound graduates who are employable in the local and global metallurgical and allied industries.
5. produce graduates that are well-rounded for post-graduate training as scholars and professionals in the academia, (including metallurgical research institutions) for national technological development.
6. Produce graduates that are sound technocrats in government who are capable of engendering good and enforceable policies for metallurgical engineering innovation towards job generation, wealth creation, industrial and economic development.

Employability skills

The employers of labour require more than certificates. Apart from knowledge, they require some requisite skills and attitudes. These skills include: leadership skills, organisational skills, interpersonal skills and ICT skills. These skills among others coupled with ontological value system will be inculcated in the students of the Department of Metallurgical Engineering so that they will not only be employable but also be potential employers of labour.

Apart from those itemized in Section 3 (Objectives), metallurgical engineering students are specially equipped for employment in public iron and steel industries like the soon-to-be revived comatose Ajaokuta Steel Complex, Delta Steel Company, the three Inland Rolling Mills at Jos, Osogbo and Katsina. Iron and steel are the basis for national industrialisation. There are a lot of private industries producing iron and steel products through recycling of metallic wastes. Recycling of waste electrical electronics to extract by secondary process precious metals such as gold, silver and platinum group of metals presents a lot of career opportunities. Also, they are able to work in the government established aluminium smelting company (Ikot Abasi). In addition, metallurgical engineering graduates can work in the academia and research institutes as lecturers, researchers and be involved in community service. Furthermore, they can work with government as technocrats for policy formulation, implementation and appraisal. There are job opportunities in the Nigerian Standard Organisation, ship building yard, sea ports, customs and as forensic engineers. Graduates of metallurgical engineering programme are expected to be capable of applying knowledge, skills and correct attitude to solve theoretical and practical problems starting with the Nigerian mineral, metallurgical and allied industries in order to meet national and international societal needs.

21st Century Skills

For the 21st century and beyond, it is imperative to produce engineers who can think critically/problem solving/decision making and bring this to bare and through deep seated imagination, innovation, design infrastructures, facilities and systems for productive, profitable and sustainable economic activities. Analytical skills, collaboration (teamwork), communication skills and digital skills and entrepreneurship among others are the desiderata for 21st Century engineering graduates and these are addressed in metallurgical engineering programme.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the

university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.

5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Sciences	Discipline (GET)	Programme (IPE)	SIWES Courses	Total Units
100	4	16	3	2	-	25
200	4	-	23	-	3	30
300	4	-	14	9	4	27
400	-	-	-	13	8	10
500	-	-	-	13	-	13
Total	**12**	**16**	**40**	**37**	**15***	**105**

* All 15 SIWES units credited in the 2nd Semester of 400-Level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Cultures	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
MTE 101	Introduction to Metallurgical Engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 201	Applied Electricity 1	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**27**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technology	3	C	45	-
MTE 302	Metallurgical Thermodynamics and Kinetics	2	C	30	-
MTE 303	Mineral Processing Technology	2	C	30	-
MTE 305	Physical Metallurgy I	2	E	30	-
MTE 307	Mechanical Working of Metals	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Wks	
	Total	**23**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
MTE 401	Seminars in Metallurgical Engineering	2	C	30	-
MTE 403	Ferrous Extractive Metallurgy	2	E	30	-
MTE 405	Non-Ferrous Extractive Metallurgy	2	E	30	-
MTE 407	Joining and Welding Technology	2	E	30	-

MTE 409	Foundry Technology	2	E	30	-
MTE 411	Corrosion Engineering	2	E	30	-
MTE 415	Metallurgical Engineering Lab. II	1	E	-	45
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**2**			

SIWES Courses

GET 299*	SIWES I	2	C	9 weeks
GET 399*	SIWES II	4	C	12 weeks
GET 499*	SIWES III	6	C	24 weeks
	Total	**15**		

*All credited in second semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MTE 501	Research Project	6	C	1st & 2nd semesters	
MTE 507	Production Metallurgy	2	C	30	-
	Total	**13**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing, brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes
At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)
(2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;

6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MTE 101: Introduction to Metallurgical Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. Differentiate between matallurgy and metallurgical engineering;
2. Explain the role of metals in human civilization;
3. Classify metals using the periodic table;
4. Explain basic terms in extractive metallurgical engineering;
5. Differentitae between physical and mechanical metallurgy;
6. Explain place of ferrous and non-ferous metals in industrialization and national economic development; and
7. Discuss the Nigerian metallurgical industry.

Course Contents

Historical development of Metallurgical Engineering: From arts to science and from science to engineering. Differentiation between metallurgy and metallurgical engineering. Importance of metals and metal products in human civilization: Stone age, copper age, iron age, nuclear age, ICT age; imagine the world without metals! A perusal at the Periodic Table; classification of metals; Metallurgical Engineering: definition and classification: Process (Extractive) metallurgical engineering. Get acquainted with terms like roasting calcination, agglomeration, smelting, smelters contract, refining and furnaces. Physical metallurgical engineering: structure - property -application relationship. Mechanical metallurgical engineering: Stress - strain relationship and application. Metallurgical engineering: ferrous & non-ferrous industries as basis for industrialisation and national economic development. Nigerian metallurgical industry; professional bodies such as Nigerian Society of Engineers, Nigerian Metallurgical Society (NMS), etc.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker);

entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and

8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting

processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters and weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents
Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr’s circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I **(3 Units C; LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity.

Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry

equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300-Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;

6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups..

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports.

Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology

(3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

MTE 303: Mineral Processing Technology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. grasp the importance of mineral processing technology as a value-addition chain in mineral resource development;
2. carry out mineralogical characterization of ferrous, base and precious/noble metals;
3. explain the basic principle involved in physical and physico-chemical processing of minerals; and
4. design process flow sheet for ores of ferrous, base and precious metals.

Course Contents

Mineral processing technology as physical and physico-chemical value addition process to mineral resource. Classification of mining title deeds into classes A-E in Nigeria. Application of mineralogy to mineral processing in an existing mill and/or process design for a new mineral processing plant. Application of scientific principles to mineral processing technology. Sampling and sampling methods. Comminution (to effect liberation) and comminution theories. Particle size analysis using vibrating set of screen. Concentration methods: physical separation methods such as sorting, gravity separation, magnetic separation and electrostatics separation. Physico-chemical separation methods such as froth floatation and coal gold agglomeration.

MTE 304: Chemical Metallurgy (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. appreciate chemical metallurgy as an important value addition process to mineral resources and the gateway to metallurgical engineering;
2. explain the principles and applications of pyrometallurgy, hydrometallurgy, electrometallurgy and refining processes;
3. describe the principle, the drawing and applications of Ellingham, Pourbaix and McCabe Thiele Diagrams; and
4. highlight recent advances in chemical metallurgy.

Course Contents

Appetizer: Sustainable mineral resources development: A relay race among geologist, miners, mineral processor and extractive (chemical) metallurgist, the concept of world without metals! The importance of chemical metallurgy as the gateway to metallurgical engineering and the fact that there is no distinct boundary between mineral processing technology and extractive metallurgical engineering. Roasting, calcination, agglomeration and leaching are at the intercession of both disciplines.

Introduction to Chemical Metallurgy: Review of metallurgical thermodynamics, kinetics and smelters contract; definition, nature and classification of chemical metallurgy.

Pyrometallurgy: Definition, roasting, agglomeration principle, methods, equipment, tools for pyro-metallurgy (Ellingham Diagram). Introduction to iron and steel making: tin smelting and coal gold agglomeration.

Hydrometallurgy: Definition, nature and scope; hydrometallurgical processes, McCabe Thiele Diagram for solvent extraction, leaching kinetics, advantages and disadvantages of hydrometallurgy: Introduction of extraction of aluminium

Electrometallurgy: Principle and application of McCabe Thiele Diagram; definition and scope; electrometallurgical methods, electrochemical series, principle and application of Pourbaix diagram in electrometallurgy; advantages and limitations of electrometallurgy.
Refining of Metals: Definition, nature and scope; vacuum refining, zone refining, re-melting, liquation, electro-beam metal, electron beam and electro-slag.
Recent advances in Chemical Metallurgy

MTE 305: Physical Metallurgy I (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. review relevant topics in Physics;
2. situate physical metallurgy within metallurgical engineering family;
3. explain physical metallurgy as application of scientific laws of physics to metallurgical engineering; and
4. describe the structure-property-application relationship as pertains to various category of metals (ferrous and their alloys, non-ferrous, base metals and precious metals).

Course Contents
Review of fundamentals of relevant topics in physics including the following: wave theory of atom, Schrödinger wave equation and calculations using the equation; wave-particle light duality; uncertainty principle; electron diffraction, theory and application. Bragg's law and application in mineral/metals characterisation as in X-ray diffractometry; classification of crystal systems, structure of crystals and introductory stereographic projection. Diffusion processes in metals and alloys. Nucleation and growth in metal casting. Dislocation and slip phenomenon. Mechanical properties of materials.

MTE 306: Physical Metallurgy II (3 Units C: LH 30; PH 45)

Learning Outcomes
This is an important core course to be mastered before students go on six months industrial training. At the end of this course, the students should be able to:
1. demonstrate being conversant with structure-property-application relationship of metals and alloys;
2. manipulate structure metals and alloys to modify their properties for specific application using appropriate scientific principles and phase diagrams;
3. draw and explain the Iron-Carbon and TTT diagrams; and
4. explain the concept of recrystallisation.

Course Contents
Binary and ternary equilibrium diagrams and applications in metallurgy; theory of alloy, solidification of metals and alloys; introduction to heat treatment of metals including normalising, tempering, quenching, annealing and case hardening of metals; phase transformation, iron-carbon diagram and TTT diagram; theory of recrystallisation, nucleation and growth of crystal.

MTE 307: Mechanical Working of Metals (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the student should be able to:
1. explain mechanical behaviour of metals;

2. demonstrate using diagram stress-strain relationship;
3. explain the concepts of deformation and strengthening; and
4. discuss on the effects of cold-working, hot-working and annealing.

Course Contents
Mechanical behaviour of materials, stress-strain diagrams for ductile and brittle metals, stress-strain relations, principal stresses, strains and directions, the Monrcircle, elastic and plastic deformations, elastic constants, plastic yield criteria. Basic concepts of dislocations, dislocation, density and dislocation motion; conservative and non-conservative motion, dislocation motion and plastic deformation. Mechanism of deformation: slip, twining, grain boundary sliding, directional diffusion. Creep, theories of creep and stress rupture. Concepts of cyclic loading and fatigue. Strengthening mechanism in metals and alloys, solid solutions, precipitation and dispersion hardening, grain size strengthening, strain hardening, martensite hardening, etc. Composite materials and fibre strengthening, hardness and strength considerations in deformation processing, effects of cold-working, hot-working and annealing.

MTE 308: Metallurgical Engineering Laboratory I (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to*:*
1. identify and be able to use basic equipment and devices in materials and metal processing and utilisation;
2. discuss practical engineering principles in materials and metallurgical processing and selection; and
3. undertake basic experiments in materials identification, classification and processing.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them;
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6

months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MTE 401: Seminar in Metallurgical Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss critical issues in metallurgical engineering as outlined in the course content;
2. make presentations on critical metallurgical topics;
3. interact freely with senior engineers in metallurgical positions and indeed the general public on cognate issues; and
4. explain the primary concepts in metallurgical engineering.

Course Contents

Restricted special topics to be covered include the following:
Heat Treatment of Metals: Emphasis on iron and steel. Definition of heat treatment, various types of heat treatments and applications of the various heat treatment in the Metallurgical Industry. *Sustainable Mineral Resources Development*: Seeing the big picture: Mineral exploration, mining engineering, mineral processing technology, and extractive metallurgical engineering as a relay race. The 'what', the 'why', the 'how', the 'who', the 'when', the 'where', and the 'which' of the four programmes and allied fields. *Leadership Skills***:** Vision, mission, and strategy in leadership. Definition of Leadership: The fact that leadership can be caught (natural attributes) and taught (leadership training). What it means to be transformational leaders; forms of leadership. Academic leadership, entrepreneurial leadership, professional leadership and political leadership. Visionary and strategic leadership. *Machine Design and Fabrication Mineral Processing Equipment:* List of equipment used for gravity separation, flotation of minerals such as shaking table, air float, magnetic separator, electrostatic separator, flotation cell, and design principle of selected machines. *Machine/Equipment Design and Fabrication (based on need-driveness):* Equipment used design and fabrication of equipment used in ferrous and non-ferrous extractive metallurgy. Different type of furnaces: Furnace Design and fabrication. *Geometallurgy:* Interface between geosciences and metallurgy, emerging, need-driven and multidisciplinary scientific field. *Geostatistic:* Critical tool for mine design among other purposes towards sustainable mineral resources development. *Rare Earth Elements*: Definition, extraction process route for this rare and expensive metals for specialised industrial applications.

MTE 403: Ferrous Extractive Metallurgy (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. appreciate the critical importance of iron and steel making in national economic development;
2. describe iron and steel making via the two major routes (blast furnace and direct reduction);
3. highlight the basic design principles of the blast furnace and direct reduction method of iron and steel production, their operations and their thermochemistry; and
4. explain the secondary steel making processes and manufacturing of alloy steel such as ferro alloy and super alloys.

Course Contents
Critical importance of iron and steel in national economic development and global steel production. The upstream, the mainstream and the downstream of iron and steel making processes. Linkage industries. Classification of iron ores and other raw materials (fuels and fluxes) for iron and steel making. Agglomeration methods: sintering, nodulising, briquetting, pelletising. Iron production route. Blast furnace and direct reduction method (the advantages and limitations of both). The blast furnace: The design, production, operations and physical chemistry of iron making and refining of liquid iron. Steel making processes, their technology and advantage, raw materials requirements and steel making practices. Thermodynamics and kinetics of steel making practices; secondary steel making processes and manufacturing of alloy steels. Argon purging and ladle alloying, desulphurisation. Principles and technology of slab and ingot casting.

MTE 405: Non-Ferrous Extractive Metallurgy (2 Units E: LH 30)

Learning Outcomes
Remove the misconception that metallurgical and materials engineering centres around iron and steel. The most important industrial metal/alloy and underscore the importance of non-ferrous metals like gold, silver, aluminium, copper, lead, nickel, chromium and lithium.
At the end of this course, the students should be able to:
1. use the periodic table to study the behaviour of metals;
2. demonstrate knowledge of the three fields of extractive metallurgy: pyrometallurgy, hydrometallurgy and electrometallurgy;
3. properly grasp the theory and application of Ellingham diagram in pyrometallurgy, McCabe Thiele Diagram in hydrometallurgy and Pourbaix diagram in electrometallurgy;
4. develop process flow sheets for extraction of common metals like aluminium, tin, copper, nickel, lead and zinc from their ores; and
5. identify techno-economic and environmental challenges in non-ferrous metal extraction industry with a view to proffering appropriate solutions.

Course Contents
Review of the Periodic Table; classification and sub-classification of extractive metallurgy. Pyro-metallurgy: Theory and application. Flow sheet development for lead, zinc, tin, gold and nickel. Hydrometallurgy Review: Theory and application flow sheet development for aluminium, copper, gold, silver and platinum group of metal (PGM). Electrometallurgy: Theory and application. Flow sheet development for gold and silver. Application of Ellingham diagram, McCabe Thiele diagram and Pourbaix diagram in pyro-metallurgy. Hydrometallurgy and electrometallurgy processing of minerals/metals respectively. Refining of metals with particular reference to gold, silver, copper and tin. Techno-economic and environmental issue in the design and operation of metal extraction and refining plants.

MTE 407: Joining and Welding Technology (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. provide the definition, scope and classification of the three main metallurgical engineering joining processes: welding, brazing and soldering;
2. discuss how the concept of heat affected zone (HAZ) is to be understood by the students;
3. exemplify theoretical knowledge and practical skills involved in welding, brazing and soldering; and

4. explain the scope and limitations of both welding and brazing.

Course Contents

Introduction: Role of welding, brazing and soldering in manufacturing processes. Welding: Definition, principle, classification and scope. Types of welding processes – gas, arc, resistance, flash, friction and electro-welding, among others. Brief treatment of new processes such as explosive welding, plasma welding and electro-beam welding. Weld rods and fluxes protective atmosphere, weld defect and weldability of metals and alloys. The effect of welding processes and mechanical properties of weldments. Heat Affected Zone (HAZ). Heat treatment of welds, design of welded joint; brazing: scope and limitations, types, processes, brazing of commercially important ferrous and non-ferrous metals and alloys; soldering: processes, soldering alloys and application of soldering techniques.

MTE 409: Foundry Technology (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. appreciate the importance and uniqueness of foundry technology as a manufacturing process;
2. distinguish between foundry and casting;
3. describe departments in typical foundry shop and their functions;
4. highlight the application of scientific principles in design of gating and rising system.
5. demonstrate skilfulness in charge calculations;
6. identify design and operational casting defects, their causes and preventive remedies; and
7. derive a typical process flowchart of foundry production.

Course Contents

Historical development of foundry technology. Situating casting as an important manufacturing process. Distinguishing foundry as an establishment and casting as both as process and product. Bases for classification of foundries: ferrous and non-ferrous, captive and jobbing. Application of scientific principles such as law of continuity, Bernoulli equation, and Torricelli equation in the design of gating and rise-ring system in a casting. Directional solidification. Casting methods: sand, investment, pressure, vacuum and permanent mould casting. Various departments in foundry and their functions, process selection, design and specification. Determination of casting techniques, mould and core making, pattern making, furnace charge, casting and finishing; charge calculation, casting defects: design and operation defects, definitions, preventive and curative measure to casting defects.

MTE 411: Corrosion Engineering (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain in details what corrosion is;
2. discuss the socio-economic implications of corrosion and the need to prevent same in manufacturing processes, materials selection and surface finish;
3. describe the Pourbaix diagram and its application to corrosion prevention and control; and
4. develop the necessary skill on methods of corrosion control and prevention by inhibitors, surface coating and electroplating.

Course Contents
Two view points on corrosion: extractive metallurgy in reverse and electrochemical degradation of materials which is within the purview of physical metallurgy and electrochemistry; socio-economic implications of corrosion and need to prevent it; emphasis on the thermodynamics and kinetics of electrochemical corrosion of metals and alloys; description of metallurgical factors, effect of applied stress corrosion, cracking corrosion fatigue and passivity; methods of corrosion control and prevention including alloy selection, inhibitors, anodic and cathodic protection, coating and electroplating.

MTE 413: Metallurgical Process Design (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. appreciate the fact that they are first engineers before being a metallurgical engineer;
2. be acquainted with engineering design principles, engineering materials processing and selection;
3. explain energy utilization and conservation; and
4. undertake specific design projects.

Course Contents
Design of metallurgical processing systems: whether it is extractive, physical or production system; method of estimating process costs and profitability; performance selection and design of process equipment; integration of process units into a working plant: its construction and operation; design of metallurgical equipment: furnace, ball mills, flotation cells, mixers, sinters and metals forming mills; personnel management

MTE 415: Metallurgical Engineering Laboratory II (1 Units E: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. be acquainted with practical engineering principles in materials and metallurgical processing and selection;
2. explain basic engineering issues in utilization and conservation; and
3. undertake specific prracticals relating to handling of materials and metals.

Laboratory manuals are prepared by the Department and are kept in the laboratory and also given to the students.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MTE 501: Research Project (6 units C: 270)

The students carry out research into selected researchable and need-driven topics pertaining to mineral & metallurgical industries. They will be expected to carry out literature review on chosen topics, perform experiments and produce reports. Students will be subjected to both seminars and oral examinations (by both internal and external examiners) on their research projects.

MTE 502: Materials Selection and Economics (2 Units C: LH 30)

Learning Outcome

At the end of this course, the students should be able to:

1. choose suitable materials – metals, ceramics, polymers and composites for specific application;
2. make the right choice from techno-economic, environmental and safety viewpoints;
3. demonstrate knowledge of the properties of materials that make them the practical choice in various applications; and
4. explain fabrication, heat treatment and surface treatment in the production of satisfactory components.

Course Contents

Metallurgical engineers and techno-economic consideration; selection of engineering materials by the metallurgical engineer for specific applications such as in oil and gas, saline environment, construction, high temperature environment, nuclear, electronics, aerospace industries based on techno-economic considerations. Physical, mechanical, chemical, electrical, magnetic and thermal properties of engineering materials: metals, ceramics, polymers, composite and their production. Structure-properties-application relationship of materials and their selection based on cost-benefit analysis, environmental friendliness and safety. Factors governing the selection of materials for specific applications needs.

MTE 503: Transport Phenomena in Metallurgy (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. exhibit the scientific understanding that metallurgical processes are provided by transport phenomena;
2. explain the interplay of fluid, mass and momentum transfer in metallurgical systems;
3. appreciate metallurgical engineering within engineering-technology family, differentiate between the three types of fluid flow; and
4. apply the principles covered in the design of specific metallurgical systems.

Course Contents

Viscosity: definition, kinetic viscosity, dynamic viscosity and Reynolds constant. fluid Flow: laminar, transitional and turbulent flow. Mechanical flow: Bernoulli equation, flow jet kinetic and kinematics; thermal conductivity, steady and transient conduction problems, forced and natural convection, heat transfer and radiative heat transfer. Definition of binary diffusivity, convection mass transfer and mass transfer coefficient. The application of the principles covered in the design of specific metallurgical systems.

MTE 504: Fuels Refractories and Furnaces (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. appreciate the centrality of the core course to the different specialties of metallurgical engineering;
2. identify and select suitable refractories for the building of specific furnaces;
3. design and build functional furnaces (blast furnace, reverberation furnace, electric furnace, open heath furnace converter and fluidized bed reactors); and

4. carry out tests on coals to ascertain the cokeability and cakeability of such coal as metallurgical fuel and thus make the right choice of fuels for the blast furnace.

Course Contents
Survey of main engineering fuel: solid, liquid and gaseous fuels; classification and testing of fuels; fuels and energy utilisation in the metallurgical industry with reference to coking coals for iron and steel production via blast furnace; introduction to coal and coke technology refractories; technology of production and services of main metallurgical refractories: silicon, magnesite, chrome-magnesite, alumina-silicate and other refractories; special refractories, their evaluation and applications in furnace construction; classification of metallurgical furnaces and reactors, their design and construction.

MTE 505: Powder Metallurgy (2 Units C: LH 30)
Learning Outcomes
At the end of this course, the students should be able to:
1. appreciate the fact that this is an important manufacturing process that stands between the traditional manufacturing processes such as casting, machining, metal joining processes, metal working processes, and the emerging manufacturing processes such as additive manufacturing and nanotechnology;
2. explain the concept, the content and the context of powder metallurgy principles;
3. explain how this knowledge can be applied in industries; and
4. possess background knowledge to envision future trends in powder metallurgy.

Course Contents
Introduction to powder metallurgy; applications of powder metallurgy techniques in industries; methods of production of metal powders, grinding and blending of powder; compaction by pressing, extrusion, rolling and explosive techniques; sintering, sizing and impregnating; sintered products; advantages and disadvantages of powder metallurgy techniques; safety engineering in powder metallurgy industries; future trends in powder metallurgy.

MTE 506: Engineering Failure Analysis of Metallic Materials (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. situate engineering failure analysis under the broader field of forensic engineering;
2. explain the principles of manufacturing and mechanical metallurgy and how they can be applied to engineering failure analysis;
3. give appropriate tests that can be done to analyse the cause; and
4. explain what steps can be taken to prevent a particular failure in future.

Course Contents
Application of the principles of manufacturing and mechanical metallurgy to the analysis of failed components; destructive tests (hardness test, compressive test, tensile test, fatigue test, impact test, creep test) and non-destructive test (such as magnetic, resonance, eddy current effect) of metallic materials; analytical techniques such as optical microscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM), and high-resolution photography for characterisation of microstructure and fractographic failures; appropriate methods to gather data, analyse the data and draw valid conclusions therefrom.

MTE 507: Production Metallurgy (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the principle of metal forming processes that will lead to acquisition of practical skills;
2. highlight the concepts of rolling and drawing;
3. discuss forging and extrusion processes and their applications; and
4. develop entrepreneurial spirit.

Course Contents
Mechanical working of metals: principles of hot and cold working of metals. Structural and properties changes during hot and cold working. Nature of stresses, strains and metal flows in various metal working operations; heating of stock: soaking pits and re-heating furnaces, de-scaling steel, precautions to be taken during reheating of ferrous and non-ferrous metals. Rolling: theory of rolling, rolling mills and accessories, elements of roll pass design, rolling defects, lubrication in rolling, manufacture of rolled product. Application of rolling and its limitation. Rod/wire drawing: Theory of rod/wire drawing, rod/wire drawing accessories, rod/wire drawing defects, manufacture of rod/wire drawing products, application of rod/wire drawing and their limitations. Tube drawing: Theory of tube drawing, tube drawing accessories, tube drawing defects, manufacture of tube drawing products, application of tube drawing and limitations of tube drawing, seamless tubes; deep drawing: theory of deep drawing, deep drawing accessories, deep drawing defects, manufacture of deep drawing products, application of deep drawing and its limitations. Forging, types of forging processes, forging equipment and forging defects. Roll forging and rotary swagging; extrusion: theory of extrusion, application and limitations, types of and variables in extrusion, extrusion equipment and lubrication in extrusion.

MTE 508: Recycling of Metallllic Waste and Environmental Protection (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. appreciate that in all mineral and metal value addition chain, safety of lives comes before economic gain;
2. internalise that environmental protection of both flora and fauna should be taken before, during and after metallurgical operations;
3. explain some safety procedures and environmental protection guidelines; and
4. ensure qualitative secondary production of iron and steel through recycling of metallic waste.

Course Contents
Safety precautions, environmental protection and regulations for mineral processing, metal extraction, melting, casting, forming and finishing operations. Environmental risk analysis; environmental ethics and environmental control technology. Introduction to urban mining: recycling of iron and steel scraps, recycling of metallic waste especially waste electrical electronics (WEE) to recover precious metals.

New

Minimum Academic Standards

Equipment

List of Required New Laboratories and Equipment

The laboratories in the metallurgical engineering programmes should be upgraded to the following seven laboratories. The required laboratories for the metallurgical engineering programme are as follows:

1. Mineralogical Analysis and Mineral Processing Laboratory
2. Facilities for Metallographic Studies and Microscopy

3. Ferrous Extractive Metallurgy Research Laboratory
4. Non- Ferrous Extractive Metallurgy Research Laboratory
5. Engineering Failure Analysis Workshop and Laboratory (For metallic materials)

6. Foundry Laboratory Facilities and Testing/Measuring Equipment
7. General Metallurgical Laboratory Facilities

Mineralogical Analysis and Mineral Processing Laboratory

The required equipment for characterisation and preliminary process design of minerals include but are not limited to the following:

1. Set of sieves
2. Vibrating shakers
3. Ore microscope for petrographic investigation
4. Atomic absorption spectrophotometer (AAS) with Au, Ag, Pb, Cu, Zn, Pt lamps for chemical analysis of precision metals.
5. X-ray diffractometer (with box file) for mineralogical assemblage of an ore.
6. X-ray florescence for chemical analysis of base metals.
7. Scanning electron microscope.
8. PH meter
9. PH electrodes
10. Laboratory sample divider

The required equipment in this laboratory and their accessories include but are not only limited to the following: Top loading balance Comminution and particle size analysis equipment and accessories:

1. Crushers of various categories
2. Grinders of various categories
3. Set of sieves of all sizes with sieving machine for particle size analysis
4. Vibrating shakers
5. Particle size analyser
6. *Physical concentration equipment and accessories*
7. Gravity separation equipment which include

a. Shaking Table
b. Air float
c. Jig
d. Dense media separation
e. Spiral
f. Gravity concentrator
g. Viscometer
h. Magnetic separator
i. Electrostatic separator
j. *Physico-chemical concentration equipment and accessories*

i. Froth flotation cell
ii. Coal gold agglomeration apparatus

Facilities for Metallographic Studies and Microscopy

1. Olympus Microscope, BHT 312 with PM 10 photomicrographic outfit, Ref. No. N-MKH-340-E with facilities for dark field and bright field.
2. Photomicrographic outfit, Olympus PM6, No. N-NMX-450-030F
3. Adapter for use of PM6 with stereoscopic microscope No. N-NMX-4520-502B
4. Illuminator, Olympus Model LSG-2 NO N-NMC0-200-010T
5. Illuminator, Olympus Model LSG-2 NO N-NMC0-215-010F
6. Achromatic objectives magnifications X4, X10, X20, X40, X100, X250, X500
7. Nikon Photomicrographic Attachments, microflex FX-Series (Complete with 35mm camera, mechanical shutter mechanism-photocell and direct reading exposuremeter)
8. Extra lenses for Nikon system: CF objectives Lenses, M.PLAN 50X, 100X and 200X
9. Standard Buehler Metallograph (or Versmet – 2 Metallograph, Unitron Instruments)
10. Belt grinder for rough grinding of metallographic specimens
11. Buehler metallographic rotary polishing wheels (ECOMET I and ECOMET II)
12. Wet grinding deck (to take 4 trips of emery paper)
13. Buehler polishing cloth (Selvyt and Nylon types)
14. Buehler moulding compound (specimen mounting compound); plastic kit (plastic liquid and powder type) required
15. Alumina polishing powder (1.0µm and 0.6 µm)
16. Buehler emery paper rolls or strips for use on a 4-deck land polisher (sequence of 240, 320, 400 and 600 grits)
17. Scanning electron microscope (SEM) complete with accessories
18. Ion beam thinning equipment (for etching/thinning of TEM specimens)
19. Chemical thinning equipment (for etching/thinning of TEM specimens)
20. Films, plates and related auxiliary facilities for optical microscopy, SEM and TEM
21. Transmission scanning microscope (TEM) complete with accessories
22. Metallurgical microscopes
23. Enlarger
24. Metal enlargement easel mask
25. Dryer cabinet
26. Darkroom timer
27. Darkroom lamp

Ferrous Extractive Metallurgy Research Laboratory

Pyrometallurgical Laboratory

1. This laboratory should have equipment and accessories for roasting, calcination and agglomeration (nodulising, sintering, pelletising and briquetting).
2. Functional induction furnace for melting of iron and steel
3. Laboratory pelletising drum
4. ISO drum tester
5. Pellet hardness apparatus
6. Permeability testing equipment
7. Gas analysers for CO, H_2, CO_2, among others
8. Reducing furnace with accompanying chemical balance
9. Softening testing apparatus
10. Sinter grate machine

11. Digital temperature indicators reading - 250°C to 1600°C (or other appropriate temperature range)
12. Induction furnaces

Coal and Coke-Making Laboratory
This laboratory is meant for assessment of coals for metallurgical coke-making and relevant equipment and their accessories will be needed to carry out the following functions:

1. The following qualities of coals will be determined: petrography, coking and caking.
2. For petrography, equipment will be needed for reflectogram, macenal analysis and rank determination.
3. For coking, relevant equipment will be required for gray-king coke type, Geeseller, plastometer and dilatometer
4. For caking, equipment will be required for Roga index(RI) and free-swelling index (Psi)
5. Bomb calorimeter (for measuring ash contents of coal and coke)

Non-Ferrous Extractive Metallurgical Research Laboratory

Equipment for the following speciality of non-ferrous extractive metallurgy:
1. Pyrometallurgy equipment and accessories including furnaces and crucibles
2. Analysis of gold by fire-assay gravimetric method equipment and accessories
3. Hydrometallurgy equipment and accessories
4. Electrometallurgy equipment and accessories

This laboratory will be dedicated to process design for:
1. Precious metals like gold, silver, and Platinum group of metals
2. Base metal like Cu, Pb, Zn, Ni, Sn
3. Most important non-ferrous industrial metal: Al,
4. Radioactive metals like uranium, plutonium and monazite
5. Rare earth elements like lithium and cerium

Engineering Failure Analysis Workshop & Laboratory (For Metallic Materials)
In this workshop, engineering materials (especially metals) integrity assessment will be carried out. The following equipment among others will be required:

Destructive testing of metallic materials
1. Universal testing machine for tensile, compressive and hardness tests
2. Impact testing machine
3. Fatigue testing machine
4. Green testing machine

Non-Destructive Test (NDT)
The equipment and accessories required include the following:
1. Magnetic
2. Resonance
3. Eddy current effect
4. Dye penetrant

Metallography: Equipment and accessories
The equipment and accessories required include the following:

1. Bakelight
2. Polishing machine
3. Etchant
4. Metallurgical microscope

Fractography Equipment and accessories
Microscopy: Equipment and accessories

1. Optical Microscope
2. Scanning electron microscope (SEM)
3. Transmission electron microscope (TEM)
4. Stemming electron microscope
5. Scanning Transmission electron microscope (STEM)

Foundry Laboratory Facilities and Testing/Measuring Equipment

Equipment and tools for a foundry workshop:

1. The design shop
2. Pattern shop
3. Mould and core preparation section
4. Melting section
5. Finishing section

So that students have necessary skills so as to be able to produce the following items while still in school:

a. Grinding disk for local grinders
b. Aluminium pots, spoons and stove heads
c. Break drum for automobiles
d. Local axe heads
e. Hand bills
f. Wheel balancing weights
g. Retort stand
h. Railway brake block
i. Damaged/failed part
j. Test specimen weight scale; weighing range 0-210 gms, sensitivity 0.2 gms

Design Office
1. Drawing board with stand
2. Tee-square
3. Drawing set (rotring)
4. Set-square (adjustable)
5. Tracing paper
6. Vernier calliper
7. Consumables, pencils, erasers and drawing sheets
8. Foundry analyser

Pattern making shop
1. Hammer
2. Mallet

3. Punches
4. Stanley E-clamp
5. Stanley G-clamp
6. Vernier calliper
7. Tape rule
8. Wood drill machine
9. Stanley planer (smooth)
10. Stanley planer (Dutch)
11. Shrinkage allowance scale
12. Jig saw
13. Dovetarl saw
14. Chisel (turning)
15. Chisel (flat)
16. Oil stone
17. Files
18. Consumables include pencils, nails, adhesives, emery cloth.

Mould and core making sections
1. Mould boxes or flasks
2. Sieve or mesh
3. Shovel
4. Rammer
5. Wheel barrow
6. Head pan
7. Gloves
8. Oven (core making)
9. Facing board
10. Soft brush
11. Bellows
12. Knife
13. Sprue pins (cut pipes)
14. Hand towel
15. Muller
16. Consumables in this section include bentonite resin.
17. Drying cabinet for foundry sand
18. Sand rammer
19. Electric permeability meter
20. Foundry moisture teller (for foundry sand)
21. Universal sand strength machine (motor driven)
22. Sand flowability meter for testing flowability of moulding sand
23. Impact penetration tester for testing compaction, plasticity and hardness of moulds
24. Laboratory sifter (for determination of grain size fractions of dry moulding sand)
25. Permeability metre (manually operated) for testing sand mould
26. Core drying oven for drying core sand test specimens
27. Continuous clay washer for removing all particles smaller than 0.02 mm simultaneously from two clay bonded foundry samples
28. Moulding machine for foundry
29. Moulding sand mixer, capacity 0-20 kg, 1-50 kg
30. Metal moulding boxes
31. Foundry moulding tool kit
32. Bench mounted sieve shaker

Melting and casting section
Furnace construction
Laddle
Carrier
Tade
Long bar
Skimming bar
Burner
Drum for oil
Gloves
Fireproof coat
Hose
Muffle furnace for heat treatment
Blower
Morgan crucible tilting furnace for melting of cast iron and non-ferrous metals
Lift-out crucible furnace for non-ferrous metals
High frequency induction melting furnace
Degasser for all non-ferrous alloys to be used in tilting furnaces and bale-out furnaces
Foundry bellows

Finishing section
Metallurgical microscope with camera attachment
Grinding machine (3 phases) GSW 30
Hand drilling machine
Hacksaw
Raw materials requirement: bentonite, moulding sand, diesel

General Laboratory Facilities

1. Instron universal testing machine complete with accessories (floor and table types) with load cells and jaws for polymers and fibres
2. Automated X-ray powder diffraction system with all accessories
3. X-ray quantometer with all accessories
4. Chemical analysis equipment: Emission spectrometer equipped with all accessories
5. Metascope: Fluorescent analyser for quick composition analysis
6. Electron microprobe analyser
7. Charpy impact test equipment with all accessories
8. High temperature and room temperature creep testing machines complete with accessories
9. Fatigue testing machine complete with accessories
10. Pneumatic mounting press
11. Controlled atmosphere sintering furnace (Tem. up to 1450°C)
12. Single crystal growing furnace complete with accessories (Tem. up to 1550°C)
13. Vacuum equipment for vapour deposition plating
14. Potentiostat/galvanostat complete with all accessories

The Department should see to it that the laboratory experiment manuals are updated and upgraded using the format below:

MTE 308: Metallurgical Engineering Laboratory I
1. Mineralogical Analysis and Mineral Processing Laboratory
2. Ferrous and Non-Ferrous Metal Extraction Laboratory
3. Metallography Laboratory and Microscopy Laboratory

MTE 415: Metallurgical Engineering Laboratory II
1. General Metallurgical Laboratory
2. (For Physical and Mechanical Metallurgy) Heat treatment and propertive??? testing Destructive Testing and Non-Destructive Testing
3. Foundry Workshop

MTE 509: Metallurgical Engineering Laboratory III
1. Welding Workshop
2. Corrosion Control and Electroplating Laboratory
3. Engineering Failure Analysis Laboratory

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;

2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices
Academic and Non-Academic Spaces

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's office	18.50
Head of Department's office	18.50
Tutorial teaching staff space	13.50
Other teaching staff space	7.00
Technical staff space	7.00
Science staff research laboratory	16.50
Engineering staff research laboratory	14.50
Seminar space per student	1.85
Drawing office space (A.O. board) (Per student)	4.60
Drawing office space (A.I. board) (Per student)	3.70
Laboratory space	7.50
Non-Academic	
Secretarial space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor		Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.

B.Eng. Mining Engineering

Overview

The content of this curriculum is for Bachelor of Engineering (B.Eng) degree programme in Mining Engineering. Mining engineering deals with exploration, extraction and use of mineral resources and development mining and mineral policy. The mining engineer is concerned with all phases of mineral recovery, including exploration, evaluation, development, extraction, reclamation, processing and marketing of mineral commodities. Appropriate courses have been developed in the key areas of mineral exploration; mine and processing plant design, planning and development of surface and underground mines; mining of metallic and non-metallic minerals; rock mechanics, aggregates and industrial minerals production; excavation techniques and explosives engineering; mineral beneficiation for value addition; health and safety in mines and processing plants, mineral economics and law, environment effects of mining / processing and remediation and management of mineral projects (mines and beneficiation plant).

The overall focus of the programme therefore is exploring, extracting, and processing of metallic ores (copper, nickel, zinc, gold and others), precious stones (gems, diamonds), fuel minerals (coal, bitumen/oil sand, petroleum and gas, uranium and others) and industrial minerals (clays, stones, aggregates and many others).

Philosophy

The philosophy of the programme is to train engineers and equip them with appropriate knowledge and skills required for the operation of a vibrant mineral industry which can serve as a vehicle for rapid transformation of the economy.

Objectives

The main objectives of the programme are to:

1. train mining engineers for the solid minerals and oil industry;
2. provide a broad-based training in minerals engineering such that the products of the programme can perform effectively in prospecting, exploration of minerals (solid and oil), mining, processing and marketing of mineral commodities;
3. produce graduates that can easily be upgraded through postgraduate training to undertake teaching and research in institutions of higher learning and undertake consulting services in all aspects of the minerals industry; and
4. generate knowledge into new technological possibilities through research and development to improve technical services to the minerals industry.

Employability Skills

A product of this programme will provide technical services in all aspects of mining and minerals engineering. The category of engineers trained in this programme will function as mining engineers in the public and private sectors including federal ministries and agencies, state and private mining companies, oil and gas industry, mineral processing establishments, mining and mineral processing equipment and machinery manufacturing organisations, mineral commodities and equipment marketing and distribution companies, consulting services as well as the academia in both local and international environments. The products of this programme will also be sufficiently competent and technically equipped to establish and operate mining, processing, mineral commodities market, minerals analyses and environmental evaluation and remediation as professional services for companies, government agencies, artisanal operators and the public.

21st Century Skills

Mining in the 21st century involves the development of skills which are essential in today's global economy. In addition to the basic scientific, engineering and professional skills acquired, the mining engineer trained under this programme must have and be able to apply 21st century skills such as:

1. critical thinking/problem-solving/decision making;
2. creativity and innovation;
3. collaboration (teamwork);
4. communication;
5. learning to learn/metacognition;
6. lifelong learning;
7. high professional and ethical standards;
8. ability to work effectively in interdisciplinary teams; and
9. development and use of software packages for acquisition, interpreting and presenting exploration data, creating 3-D model of orebody, design of 3-D profiles of surface/underground mines and their facilities; design and plan excavation sequences and other unit operations.

Unique Features of the Programme

This programme compares very well in content to similar programmes in other universities around the world, some of which have been running mining engineering programme for over a century and are top-ranking among institutions for higher learning worldwide. However, unlike the programmes of some of those institutions which present partial knowledge in favour of narrower specialisation of the profession, this curriculum presents a complete body of knowledge of the profession (the extractive industry) and yet allows for focus toward specialisation and development of 21st century skills. This will enable products of this bachelor programme to fit competently into any area of the mining engineering profession upon graduation.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**General Studies**		**Basic Sciences**	**Faculty**	**Dept.**	**SWEP***	**Total**
	(GST)	**(ENT)**		**(GET)**	**(MNE)**		
100	4	-	16	0	5	-	25
200	2	2	-	23	-	3	30
300	2	2	-	15	5	4	28
400	-	-	-	-	0	8	8
500	-	-	-	5	9	-	14
Total	**8**	**4**	**16**	**45**	**19**	**15***	**105**

* All 15 SIWES units credited in the 2nd Semester of 400-Level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-

PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I & II	2	C	-	90
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
MNE 102	Introduction to Mining Engineering	2	C	30	-
MNE 104	Physical Geology and Earth History	3	E	45	-
	Total	**28**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I (SWEP): Student's Work Experience Scheme	3	C	9 weeks	
	Total	**27**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction toArtificial Intelligence & Machine Learning and Convergent Technologies	3	C	45	-
MNE 301	Mineral Exploration 1 – Geological & Geochemical	3	C	45	-
MNE 302	Drilling, Explosives and Excavation Engineering	2	C	15	45
MNE 304	Mineral Processing Technology	3	E	45	45
*GET 399	SIWES II / MNE 320	4	C	12 Weeks	
	Total	**24**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
MNE 401	Rock Mechanics	3	E	30	45
MNE 403	Mining Methods I – Surface Techniques	3	E	45	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

***SIWES Courses**

Course Code	Course Title	Units	Status	PH
GET 299	SIWES I	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15***		

* All SIWES units credited in the 2nd Semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
MNE 501	Mine Design I - Design of Surface Mines/Facilities	3	C	30	45
MNE 502	Mine Surveying	3	C	30	45
MNE 503	Mine Ventilation	2	E	15	45
MNE 504	Mine Design II: Design of Underground Mines/Facilities	3	C	30	45
MNE 505	Mining Methods II – Underground Techniques	3	E	45	-
	Total	**14**			

NOTES:
1. Some of the programme (i.e., MNE) courses listed may be taught by departments like Mechanical Engineering, Civil Engineering, Applied Geology, Applied Geophysics and Metallurgical and Materials Engineering.
2. Mineral Exploration I & II will specifically be mounted for Mining Engineering since they are usually fragmented in Geology and Geophysics.

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;

3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning, Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights;
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs);
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids

and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)

(2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work,

potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour Of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

MNE 102: Introduction to Mining Engineering **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. recognize the types of rocks that exist;
2. differentiate between rocks and minerals;
3. differentiate between surface and underground mining methods;
4. identify the roles of mining engineering in national development;
5. explain how to operate a safe mine environment;
6. relate the links between mining engineering and its allied professions;
7. determine whether a mineral deposit is economically viable or not;
8. identify when to apply a particular mining method;
9. become acquainted with applications of GIS and remote sensing in mining;
10. explain how to process different types of minerals; and
11. recall how to process and acquire different licenses, leases and mineral rights.

Course Contents

Rocks and minerals: origin, distribution, diagnostic features and classification. Energy, minerals and water resources. Minerals in national development. Introduction to mineral prospecting and exploration by geological and geophysical methods. Development of mining technology – surface mining, underground mining and other novel mining techniques (gasification, liquification, in-situ leaching enhanced recovery, etc.) Mine surveying and the Geographic Information System (GIS). Stages in the life of a mine. Unit operations in mining. Mining and its environmental consequences. Processing and uses of minerals. Introduction to mining allied programmes - Metallurgical and materials engineering, Civil Engineering, Geology, Geophysics and Meteorology. The mineral resources of Nigeria. Introduction to licenses, leases and rights acquisition.

MNE 104: Physical Geology and Earth History (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify the different landforms and the processes that produced them;
2. explain the phenomenon of weather and other surface processes of the earth and their significance in mineral deposition;
3. describe geologic structures, their classification and their deformation processes;
4. identify earth mineral and energy resources and their classification;
5. identify the importance of energy sources – water current, wind, gravity, glacial and their roles in mineral deposition; and
6. carry out practical identification of common mineral forming rocks.

Course Contents

Planet Earth - its composition from core to crust. Weathering and other surface processes- principles, agents: - physical, biotic, chemical processes. Landforms and major earth structures: principles and processes of erosion, transportation, sedimentation and evolution of landforms. Water current, wind, gravity and glacial ice as agents of erosion and their deposition landforms. Ocean processes- turbidity currents and turbidites. Deformation processes and structures- joints, faults and folds; classification of faults and folds. Igneous intrusions: -discordant and concordant intrusion. Concordant and discordant intrusion – sills, laccoliths, lopoliths, dykes, cone sheet, batholiths, plugs, stocks, bosses, veins, etc. Earth resources – waters, energy and minerals. Minerals and rocks -origin, distribution, identification and general classification. Practical identification of common rock – forming minerals and rocks.

200 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation **(2 Units C: LH 15; PH 45)**

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies).

GET 201: Applied Electricity I **(3 Units C: LH 30; PH 45)**

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;

4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types; 3. numerically solve differential equations using MATLAB and other emerging applications;
3. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
4. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
5. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
6. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;

7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;

5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project. Examples of projects should include the following:

a. design of machine components
b. product design and innovation
c. part modelling and drafting in solidworks
d. technical report writing

MNE 301: Mineral Exploration I - Geological and Geochemical
(3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. determining the mode of occurrence and factors controlling ore deposition;
2. explain the sequence of mineral or ore search by reconnaissance, prospecting and detailed exploration;
3. identify and select geological methods of mineral and ore exploration;
4. identify applicable geological sampling techniques;
5. state geological data type, their processing, analysis and presentation;
6. apply the concept of geochemistry as indicators of mineral presence;
7. determine applicable geochemical surveying, principles and methods of exploration;
8. apply elements mobility and dispersion patterns for mineral search in geochemical environment;
9. state geochemical data type, acquisition techniques, processing and presentation; and
10. select appropriate procedures for geological and geochemical exploration.

Course Contents

Relative abundance, classification and distribution of elements in the cosmic system (lithosphere, hydrosphere and atmosphere). Mode of occurrence and factors controlling ore deposition. Concepts of ore search: reconnaissance, prospecting and detailed exploration by geological, geochemical and geophysical techniques. Geological exploration - zoning, pitting, trenching, drilling and remote sensing. Drill-hole section and plan interpretation methods of core logs. Geological data representation, presentation and interpretation. The concept of geochemistry. Geochemical environments and distribution of major and trace elements in primary and secondary geochemical environments. Geochemistry of different rock types and mineral deposits. Geochronology, weathering of major rock and geochemical implications. Dispersion patterns and mobility of elements. Geochemical cycles of some major elements. Geochemical surveying, principles and methods of exploration. Geochemical sampling media, field operations, sample collection, preparation and analytical procedures. Data processing, presentation and interpretation (map preparation). False anomaly: description, causes and remedy. Principles of major and trace elements analysis. Introduction to the use of relevant computer packages for data analyses and graphical presentation.

MNE 302: Drilling, Explosives and Excavation Engineering
(2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate a clear understanding of drilling techniques;
2. design suitable drilling pattern for blasting;
3. evaluate explosives properties and select appropriate explosive for rock blasting;
4. identify applicable blasting parameters and firing pattern;
5. differentiate blasting methods in surface, underground, tunneling and road ways;
6. design stationary and mobile magazines for safe handling of explosives and blasting accessories; and
7. control disturbances associated with drilling and blasting.

Course Contents

Rock characteristics affecting drilling - engineering properties of rock material, rock drillability and blastability. Classification of drilling and penetration methods. Theories of rock penetration. Rotary, percussive, rotary-percussive and thermal drilling. Drill bits and their applications. Diamond drilling and core recovery. Basic parameters affecting bench drilling (bench height, burden, spacing and drilling pattern). Choice of drilling equipment. Drilling components manufacturing process (drilling rods, bids, coupling, pistons, etc.). Handling and maintenance of drilling equipment. Definition of explosives. Brief history of explosives. Terminology and definition – velocity of detonation, density, detonation pressure, sensitivity, strength, water resistance and fume characteristics. Properties and classification of explosives – dynamites, ammonium nitrate and fuel oil (ANFO) cracking agents. Explosive accessories. Magazine construction. Blasting methods and practices in surface and underground workings. Blasting patterns; special blasting techniques – smooth, presplitting, secondary blasting procedure. Disturbances created by blasting. Applications in dimension, aggregates, water well, water works, hydropower, road works, railways, pipelines, built-up areas, etc., underwater blasting, underground blasting (tunneling, shafts, chambers).

MNE 304: Mineral Processing Technology (3 Units E: LH 45; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the structures and textures of minerals and their significance in mineral genesis and treatment;
2. explain ore compositional analyses by chemical and mineralogical techniques;
3. explain the basic comminution and liberation theories and particle size presentation by various methods;
4. apply the principles of mineral separation by heavy medium, magnetic, gravity, flotation, leaching, biological recovery processes and other separation techniques including the physical and mechanical processes of amalgamation and agglomeration;
5. prepare metallurgical mass balance – recovery, grade and loss;
6. identify mineral components of an ore under different light conditions in the petrographic microscope;
7. carry out basic laboratory experiments in ore comminution, particle liberation and present particle sizing data technically;
8. skillfully carry out bench-scale recovery tests using appropriate separation process; and
9. develop process flowsheet for a mineral processing plant and determine recovery, losses and grades.

Course Contents

Ores, minerals and rocks. Structures and textures of minerals and their significance in mineral genesis and treatment. Ore analysis: qualitative and quantitative assaying and mineralogical analysis. Basic comminution theory, comminution and liberation. Particle sizing: sizing by screening and sizing by classification. Particle size analysis. Mineral concentration techniques - heavy medium separation, magnetic, gravity, flotation and other separation techniques including the physical and mechanical processes of agglomeration. Hydrometallurgical and biological recovery processes. Preparation of metallurgical mass balance: recovery and metallurgical losses. Introduction to essential laboratory experiments in minerals engineering.

MNE 320/GET 399: Field Work and Camping (4 Units C: 9 weeks)

Learning Outcomes

At the end of the fieldwork programme, students would have been well grounded in:

1. skills for preparation of different types of maps and the methods of acquiring data for the processes;
2. application of some software packages for map making, mine design, processing, analysis and presentation of field data in various required formats (Surfer, ArcMap, Surpac, USIM PAC or MetSMART);
3. use of some hardware for map and field data interpretation and presentation;
4. calibration, setting and use of various survey and mineral exploration equipment for data acquisition;
5. selection of appropriate methods of sample collection and preservation;
6. integration of all the various areas of mining engineering and related professions for a vivid understanding of the entire extractive industry;
7. preparation of the entire fieldwork programme in a single stringed technical report; and
8. presentation of the fieldwork report orally.

Course Contents
This is a 9-week intensive field work programme designed to expose the students to most of the rudiments of the mining engineering profession. It is a practical exposure covering mine survey, geometrical mapping of mineral deposits, mining methods (drilling, blasting, excavation), geotechnical investigation, mineral processing and practical exploration. The field work is carried out in such relevant places as existing mining operations (surface and underground), processing and smelting plants, unexploited mineral deposit, petroleum and gas facilities and other relevant places. The field work is designed for a minimum of two months commencing simultaneously with the long break of the second semester of 300 level. The students are required to prepare a technical report of the entire field work and present a seminar on the field programme.

Week 1: Introduction to Maps and their Features

Introduction to camping and camp safety. Maps: topographic and geologic maps. Elements of topographic maps: orientation, parallels, meridians, scale, direction (azimuth and bearing), base directions and (true, magnetic and grid north) contour lines. Topographic profile – construction and geological interpretation. Features of mineral and geological maps: formation, outcrops, and altitude. Representations and structural symbols. Geometry of outcrops: attitude. Methods of determination of dip and strike from geological maps: strike-line method, determination from partial outcrops and subsurface data. Geological cross-section – mode of construction and interpretation. Reconstruction of geological events from geo-cross-sections. Determination of thickness of rock bed using mathematical and graphical methods. Completion of rock outcrop from its partial outcrop on maps using surface and subsurface data. Solving three-point problems using borehole data. Recognition of different types of geological structure (folds, faults and unconformities) on maps. Determination of throw of faults from simple geological maps. Igneous intrusions and their recognitions on maps. Fieldwork for map preparation and interpretation.

Week 2 to 4: Introduction to Map-making tools and Software Packages

1. Use of map-making tools – compass, GPS receivers, theodolites, levelling instrument total station, planimeter, maps and plan printers and computer set;
2. Use of surfer and ArcMap, Surpac, USIM PAC/ MetSMART or any other package; and
3. Practice sessions.

Note: If all necessary provisions are made for the fieldwork programme, these weeks and the rest of the programme duration may be spent in the camp.

Weeks 5 to 9: Field Data Acquisition and Reporting

1. Data on surveying and mineral sampling;
2. Data from practical drilling and blasting exercises;
3. Geotechnical investigation and sampling;
4. Practical exploration and reserve estimation exercises;
5. Collation and organization of data for report writing;
6. Data plots and maps drawing using relevant software packages;
7. Preparation of report; and
8. Oral presentation of field work report.

NOTE

1. While items (a) – (e) may take place during the field programme, items (f) – (h) will be done at school after the fieldwork.
2. Most of the activities are effective when done in groups.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

MNE 401: Rock Mechanics (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. determine physical properties of rock (density, porosity, permeability, and hardness.);
2. determine mechanical properties of rock (uniaxial compressive strength, triaxial compressive strength, point load strength and slake durability.);
3. explain and measure the elastic behaviour of rocks;
4. carry out stability analysis of various natural and artificial rock slopes;
5. apply RocScience software to:
    a. produce the Mohr envelope;
    b. analyse various slopes; and
    c. determine factor of safety;
6. use the point load tester;
7. use the uniaxial compressive test machine;
8. prepare rock samples using Masonry saw and rock-grinding machine;
9. prepare rock sample slide for petrographic analysis; and
10. prepare good core samples using coring machine for qualitative and quantitative analyses.

Course Contents

Introduction to Rock Mechanics – Definition of terms and importance of rock mechanics. Field applications in mining, civil and petroleum engineering. Classification and Index properties of rocks – geological classification of rocks (crystalline rocks and organic rocks); porosity density; permeability; strength: Slaking and Durability; sonic velocity as an index to degree of fissuring; classification of rock masses for engineering purposes. Rock strength and failure; criteria modes of failure of rocks common laboratory strength tests (uniaxial, triaxial, Brazilian, flexural tests); stress-strain behaviour in compression; effect of confining pressure; the meaning of rock strength; application of the complete stress-strain curve. The Mohr Coulomb failure criterion. The effect of water. The influence of the principal stress ration on failure; empirical criteria of failure; Coulom-Navier criterion of failure of rocks; Griffith brittle failure criterion. Elastic properties. Applications of rock mechanics in engineering or underground openings. Rock slope stability. Support systems design and selection – caving and subsidence. Observation of mass deformations – extensometers and strain transducers. Case studies.

MNE 403: Mining Methods I – Surface Techniques (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate a clear understanding of surface mining technologies (open pit), open cast quarrying and their design as well as the unit operations;
2. design granite quarries for production of aggregates and dimension stones;
3. explain stripping ratio for determining suitable method for exploitation of ore deposit;
4. design layouts for strip mining of coal and include important economic and environmental considerations;
5. describe the technology for marine mining and include important economic and environmental considerations; and
6. determine economic pit limit.

Course Contents

Analysis of elements of surface mine operation. Design of surface mining systems with emphasis on minimisation of adverse environmental impact and maximisation of efficient use of mineral resources. Surface excavation. The uses, handling and maintenance of surface equipment and plants. Ore reserve estimates, grade control (blending and dilution), short- and long-range planning, unit operations, equipment selection, cost estimation, slope stability and placer mining operation. Aggregates quarrying and dimension stones production. Ore handling equipment. Case studies of typical surface mines: coal, metallic and non-metallic mines. Bitumen oil sand mining. Scheduled field trips to operating mines.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;

2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

MNE 501: Mine Design I - Design of Surface Mines and Facilities
(3 Units C: LH 15; PH 45)

Pre-requisites MNE 403 Mining Methods I

Learning Outcomes
At the end of this course, the students should be able to:
1. explain what is involved in designing any type of surface mine;
2. identify the various parameters used in surface mine design and how to acquire them;
3. apply the techniques learned in designing a surface mine where required;
4. select an appropriate mining method and machineries for a given mineral deposit;
5. employ applicable software packages for design of surface mines;
6. generate mineral model from cut-off grade; and
7. design the optimum slope for safe operation and optimum recovery.

Course Contents
Design of surface mine excavation methods. Determination of bench parameters. Calculation of the width of working platform of the bench. Determination of the optimum depth of a surface mine. Selection of mine equipment and machinery. This includes draglines, loaders, power shovels, drilling rigs, jack hammer, compressor, conveyor belt, etc. Feasibility study of a proposed quarry. Design of a surface mine using an existing data. Software applications to surface mine design in planning and organisation using various software packages in the laboratory. Slope design in surface mines to ensure safe operation. Practical exercise.

MNE 502: Mine Surveying **(3 Units C: LH 30; PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between surface survey and underground survey;
2. explain the application surveying in various surface and underground mining operations;
3. explain how to operate and use basic surveying equipment in gathering data for various mine operations;
4. discuss the concept of remote sensing in mine surveying;
5. carry out practical surveying using necessary tools and equipment;
6. process field (survey) data using relevant mathematical concepts;
7. process and present information for application in cartography principles; and
8. apply surveying results in mine planning and design of three-dimensional mining layout.

Course Contents
Mining theodolite. Unique difference between mining theodolite and land surveying theodolite. Surveying in open cast mines – building and construction of an open cast deposit. Calculations for drilling, blasting, excavation, transport operations and drainage. Mine survey control in supports and stability of slopes in quarry/open pit mines. Factors affecting stability and deformation of slopes in quarry or open pit mines. Methods of calculation of angle of slope in quarry or open pit mines. Surveying in underground mine systems – control on industrial layout of underground deposits. Construction of shaft and shaft lift; mine survey work on contact with mineral surface (lava). Geometrical projections

of mine rocks and other mine features. Geometrical classification of industrial and non-industrial mineral deposit. Parameters of mineral reserve estimation and methods of quantifying mineral reserve. Concept of displacement in underground mining zone. Process of displacement of mine rocks/earth surface. Basic understanding and parameters that characterise the process of rock/earth/displacement. Factors affecting rock displacement in mineral deposit. Mine survey control on displaced mine rock/earth surface. Application of photogrammetry and remote sensing in mining. Geographic Information System (GIS) and its application in the mineral industry. Computer application in surveying, mine planning and fieldwork.

MNE 504: Mine Design II (Design of Underground Mines and Facilities) (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain what is involved in designing any type of underground mine and gallery;
2. select appropriate underground mining method and machineries for a given mineral deposit;
3. identify the various data required for the design of any underground mine and facility and how to acquire them;
4. recall the rules of conduct for safe working in an underground mine;
5. apply the techniques learned in designing underground mine where required;
6. apply applicable software packages for design of underground mines;
7. generate mineral model from cut-off grade;
8. design the best stope for safe operation and optimum recovery; and
9. undertake a practical design project in underground mining.

Course Contents

Design and construction of shafts, winze and raise. Phases of shaft construction. Different methods of shaft sinking such as bench method and Jora lift method. Detailed shaft site investigation for construction cost optimisation and safety. Detailed application of hoisting machines, tunnel, drifts and adrift design and constructions. Various methods of tunneling in underground mines using tunneling machines and explosives. Drilling and blasting parameters in shaft sinking and tunneling. Design of powered supports arch and nut and bolt supports. Design of ventilation systems in underground mines. Selection of the best methods of mining during the design of underground mines. Application of software packages to underground mine design.

MNE 505: Mining Methods II (Underground Mining) (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify and describe the various developmental methods of underground mineral deposits,
2. select applicable underground method based on ore and host rock properties;
3. apply appropriate technology for the design and construction of underground mine openings and galleries,
4. apply the methods of roof and ground control in prevention of mine accidents and ground displacement;
5. acquire the needed technology of underground mining; and

6. relate cost and operational effectiveness in the various facets of underground mining operations.

Course Contents

Selection and development of most suitable underground mining methods based on the physical and geological properties of ore deposits. Unsupported and supported underground mining methods. Tunneling engineering; construction and maintenance. Underground mining systems. Mining of averagely thick and thick deposits. Application of novel techniques for some deposits: gasification, liquification and in-situ leaching. Equipment, conveyors, cable ropeways and rope haulage, tract and trackless mining systems, hydraulic transport and pipeline systems. Calculations of ore reserve estimates, development planning and preparations for development and extraction, and construction of development openings. Conservation and environmental systems. Case studies of typical underground mines: coal, metallic and non-metallic scheduled. Field trip(s) to operating mines and tunnels.

Minimum Academic Standards

Equipment

Equipment and tools that are required for the Mining Engineering programmes are listed below according to the requirements of the major laboratories. The accessories and consumables needed for effective use of these equipment are not listed but will be requested by the department that operates this curriculum when purchasing the equipment.

Rock Mechanics Laboratory

1. Rock coring machine (Table type)
2. Rock coring machine (Pillar type)
3. Uniaxial triaxial compression machine (e.g. MECATEST)
4. Triaxial compression machine
5. Digital compression machine
6. Rock grinding machine
7. Masonry saw
8. Point portable load tester
9. Slake durability apparatus
10. Laboratory oven
11. Pocket penetrometer
12. Rock cradle
13. Schmidt hammer
14. Compass clinometer
15. Digital multimeter
16. Digital clamp meter
17. Digital noise meter (Desk and pocket types)
18. Digital compass clinometer
19. Rock core trimmer

Analytical/ Material Characterisation Laboratory

- AAS, XRF, XRD, SEM
- Provisions for wet chemical processes
- Equipment and tools for other characterization test

Survey and Photogrammetry Laboratory

1. Underground mining theodolite
2. Levelling instruments (analogue, digital and automatic)
3. Land theodolite (analogue and digital)
4. Mining compasses (analogue and digital)
5. Compass with tripods
6. Global Positioning System (GPS) – handheld and base
7. Total station (analogue and digital)
8. Printing machine for maps and plan (large formats A_3 …)
9. Plane table with tripod
10. Digital planimeter with Laptop PC
11. Laser scanner for slope monitoring

Mine Ventilation Laboratory
1. Mine air flow (Centrifugal fan rig)
2. Cross flow heat exchanger
3. Digital noise meter
4. Digital desk pH meter
5. Digital pocket pH meter
6. Manometers (analogue and digital)
7. Venturimeter (analogue and digital)
8. Photo-digital tachometer
9. Barometer (analogue and digital)
10. Differential pressure meters (analogue and digital)
11. Digital thermometers (analogue and digital)
12. Tachometer

Mine Design and Modelling Laboratory
1. Computer with table and accessories (1 T HDD, 16GB RAM, 21″ monitor)
2. Padded stools
3. Mining design, planning, processing valuation software packages and others
4. Multimedia projectors
5. Interactive board
6. Mining models

Drilling and Explosives Tech. Laboratory
1. Laboratory table drill
2. Hand held drilling machine (pneumatic power)
3. Hand held drilling machine (electrical power)
4. Portable drilling rig
5. Models of different drilling rigs
6. Models of explosive magazine

Mineral Processing Laboratory
1. Laboratory crusher (Jaw type)
2. Laboratory crusher (Cone type)
3. Laboratory crusher (gyratory type)
4. Laboratory type impact crusher
5. Laboratory ball mill
6. Roll mill
7. Mineral jigs
8. Hydro classifier
9. Shaking table

10. Spiral separators
11. Magnetic separators
12. Sluices
13. Ore microscope
14. Laboratory oven
15. Furnaces
16. Sieve shaker
17. Agitator/conditioner
18. Filters
19. Flotation machines
20. pH meter (digital and analogue)
21. Vacuum pump
22. Weighing machines

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;

2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

In addition to the university and faculty libraries, the programme must have a departmental library well equipped with specialised books and journals in both **physical collections** and **e-collections (E-Resources)** of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribed repository of:

1. institutions (national and international);
2. open access sources;
3. professional bodies' e-learning platforms, and
4. relevant international organizations;

The library must also have adequate facilities.

a. for reading;
b. provisions for lending, and
c. Reservation unit for specialised materials.

Classrooms, Laboratories, Workshops Clinics and Offices

Although other laboratories and workshops not listed here will be shared with many other departments in the faculty and university in general, the laboratories and facilities listed in the table below should be provided and equipped specifically for every Mining Engineering programme.

Laboratories & Workshop Required for the Programme

S/N	Laboratory/ Workshop	Requirements	Required Size (m)
1	Mine Surveying and Photogrammetry Laboratory	Should provide equipment and tools for practical experiments, tests (laboratory and field) and research in Mine and Engineering Surveying including remote sensing with the GIS. Computer systems, relevant software and hardware with supply of consumables should be provided for preparation of maps and plans.	18.5 x 10 x H_{RM} (with technologist's office and a store).
2	Mining System and Design Laboratory	Should have physical models of surface, underground and other mining systems for research	18.5 x 10 x H_{RM} (with technologist office's and a store)

		and demonstration. Computer systems and appropriate software packages for mine design and simulation. Provisions should also be made in this laboratory for other hardware, equipment and tools for design of surface, underground and other mining techniques. There should also be provisions for data processing, analyses and presentation.	
3	Drilling and Explosives Laboratory	This laboratory should have equipment and tools such as jack hammer (electric, mechanical or fluid powered) for drilling; physical models or table-top drilling rig. Tools such as hand augers. Models of explosives magazine and facilities for safe preparation of ANFO. Samples of the various initiation and detonation devices and large posters of various equipment for teaching aid.	50 x 20 x H_{RM} (with technologist's office and a store).
4	Rock Mechanics Laboratory	Serves as rock testing and analysis, lapidary and gemology laboratory. Provisions should therefore be made for equipment and tools for rock and stone cutting, polishing, mounting and finishing for teaching and research in all areas of rock engineering.	
5	Mine Ventilation Laboratory	Ventilation and air conditioning equipment and facilities should be provided in this laboratory. Models of underground mine galleries for flow demonstrations are required. Various environment parameter measuring equipment such as gas and dust analysers, particulate counters, weather trackers are required for teaching and research. Large posters of mine galleries and equipment that will serve as teaching aid must be provided	18.5 x 10 x H_{RM} (with technologist's office and a store)
6	Mineral	Should be adequately spacious	50 x 20 x H_{RM}

	Processing and Extractive Metallurgy Laboratory.	(if a single laboratory is provided) to accommodate equipment and facilities for teaching and research in all sections of mineral processing and extractive metallurgy.	(with technologist's office and a store).
7	Geotechnics Laboratory	Should provide equipment and tools for practical experiments, tests (laboratory/field) and research on soil and other earthen materials.	18.5 x 10 x H_{RM} (with technologist's office and a store)
8	Mine Machinery / Equipment Workshop	Wire rope type, uses and preparation, pumps and pipeline models, models of mine machinery for demonstration, equipment for metal cutting and joining including welding and measuring tools.	50 x 20 x H_{RM} (with technologist's office and a store)
9	Analytical/ Material Characterisation Laboratory	This laboratory will provide material analyses and characterisation services for other laboratories in the programme. Should have analytical equipment such as AAS, XRF, XRD, SEM and provision for wet chemical processes. Equipment and tools for other characterisation tests are also required.	• 3 rooms of 10x6 each with an office • store • maintenance room

The NUC recommends the following physical space requirement:

Academic	**m²**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Natural Gas Engineering

Overview

The Natural Gas Engineering curriculum is designed to provide the student with the strong foundation in science and engineering needed by natural gas and other related industries engaged in exploitation of natural gas resources from underground reservoirs. The curriculum blends the natural sciences (mathematics, physics, chemistry and geology) and the engineering (thermodynamics, mechanics, dynamics, hydraulics and strength of materials). The programme covers the fundamentals of natural gas engineering science and technology including the flow of fluids, drilling operations, separation processes, unit processes, inorganic and organic chemical equilibrium and economics. The programme prepares students for engineering duties in the gas industry as well as the chemical process industry. The main focus is on the identification, extraction, storage and transportation of natural gas. The primary areas of specialization are:

1. Classification of reservoirs and understanding fluid flow concepts and recovery processes
2. Estimation of natural gas reserves
3. Wel-drilling equipment and facilities
4. Surface and sub-surface production equipment and operations
5. Storage and transportation equipment/facilities and operations

Philosophy

The philosophy of the programme is to produce natural gas engineering graduates with high academic and ethical standards and adequate practical exposure for self-actualisation as well as being of immediate value to the oil and gas industry and the community in general.

Objectives

The goal and objectives of Natural Gas Engineering education and training should be in consonance with the realisation of national needs and aspirations in relation to industrial development and technological emancipation from foreign companies in our oil and gas industry. The objectives of this programme are:

1. conduct investigations into complex natural gas engineering problems and produce viable solutions that optimise the use of our local resources;
2. understand the dynamics of both the local and global oil and gas industry;
3. adapt and adopt exogenous technology in order to solve peculiar engineering problems in Nigerian oil and gas industry;
4. design natural gas engineering projects and supervise their implementation;
5. exercise original thought, good professional judgment and responsibility for the execution of oil and gas projects in a manner that guarantees sustainable development;
6. be conversant with all the materials, codes, components, machines, equipment, production techniques and systems in oil and gas industry;
7. manage people, funds, materials and equipment;
8. have good knowledge of the ethics of the engineering profession and application;
9. work alone or in a team, especially a multidisciplinary team, and also have good oral and written communication skills; and
10. engage in lifelong learning for continuous self-improvement.

Unique Features of the Programme

The unique features of the new Natural Gas Engineering programme are as follows:

1. there is emphasis on outcome-based education with clearly defined course content and learning objectives;
2. student workload is reduced to give room for independent learning and creativity;
3. The core engineering programme is enhanced with the introduction of courses like Artificial Intelligence, Machine Learning, Convergent Technologies, Data Analytic and Renewable Energy Resources which are important in a modern-day society;
4. the computer programming course is now streamlined to be on modern programming languages instead of the old FORTRAN;
5. introduction of a course on entrepreneurship in the oil and gas industry will be an eye opener to the opportunities in the oil and gas industry. This complements the entrepreneurship course taught as a General Studies course;
6. introduction of computer applications in many courses will help the students in this era of software applications;
7. the refined SIWES programme will ensure that relevant practical experience is acquired by the students before graduation;
8. there is more field exposure with the introduction of field trips in courses like Introduction to Oil and Gas Industry and Petroleum Geology;
9. we expect better understanding of Nigerian fields with the introduction of case histories. This will also bring the students closer to the industry;
10. the final-year project and Research Methods are lumped together and to be started in the first semester. This makes it possible to choose research topics and get to research methodology before the beginning of the second semester; and
11. the robust course content of our engineering communication course will help our engineers write better report and make good presentations.

Employability Skills

Graduates of this Natural Gas Engineering programme will have sufficient science, engineering and programming knowledge that they can easily adapt to working in any engineering outfit. Particularly, they should have good understanding of oil and gas business to be employed as:

1. Reservoir Engineers
2. Production Engineers
3. Drilling Engineers
4. Oil and gas Economists.
5. Oil and gas research Engineers

The graduates should also be able to work in the following oil and gas service companies:

1. Reservoir management
2. Mud logging
3. Electric and slickline companies
4. Pipeline companies
5. Oil and gas facility management
6. PVT laboratory

21st Century Skills Emphasised

The modern skills emphasised in this programme are as follows:

1. software development and application skill;
2. creativity and innovation;

3. artificial intelligence and data analytic skill;
4. critical thinking/ problem-solving/decision making skills;
5. entrepreneurship skill;
6. communication skill;
7. learning to learn/metacognition; and
8. collaboration skill (Needed for team projects).

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	General Studies	Basic Science	Discipline/ GET	Programme	SIWES*	Total Units
100	4	16	3	02	-	25
200	4	-	20	02	3	29
300	4	-	13	05	4	26
400	-	-	-	06	8	14
500	-	-	5	6	-	11
Total	**12**	**16**	**41**	**36**	**15**	**105**

*All 15 SIWES experiential courses are credited in the 2nd Semester of 400 level.

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modeling I	2	C	15	30
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GNG 113	Introduction to Natural Gas Resources Technology	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and	2	C	30	-

	Human Existence				
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
GNG 203	Rock and Fluid Properties	2	C	15	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**26**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
PNG 308	Drilling and Well Design I	3	C	45	
PNG 310	Fundamentals of Reservoir Engineering	3	E	45	-
PNG 312	Oil and Gas Production Engineering I	3	E	45	-
GNG 316	Natural Gas Utilisation and Monetisation Concepts	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**2**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
GNG 405	Natural Gas Reservoir Engineering	3	C	45	-
GNG 407	Gas to Power Generation and Emission Management	2	E	30	-
GNG 409	Natural Gas Process Plant	3	E	45	-

	Design				
GNG 413	Natural Gas Engineering	3	C	45	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**6**			

***SIWES Courses**

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24weeks	
	Total	**15***			

*All SIWES experiential courses are credited in the 2nd Semester of 400 level.

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
GNG 511	Natural Gas Technology Process Control	2	E	30	-
GNG 504	Natural Gas Reservoir Modelling and Simulation	3	C	45	-
GNG 513	Offshore Gas Production and Flow Assurance (Production III)	3	C	45	-
	Total	**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing [paragraphing, punctuation and expression], post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;

4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;

7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;

5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;

2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;

3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

GNG 113: Introduction to Natural Gas Resources Technology (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between the sectors of the Oil and Gas Industry and its value chain;
2. identify local and global historical perspective of the petroleum industry;
3. enumerate the processes involved from discovery to consumption;
4. identify the key drivers of technology and challenges in the petroleum industry and
5. identify the associated team players and opportunities available to the Petroleum and Gas Engineers.

Course Contents

Origin of Petroleum, Crude oil and gas composition and types, Petroleum exploration techniques, Global and local historical perspective of the petroleum industry, Overview of the different sectors, Challenges in the oil and gas industry, renewal and non-renewal energy drive and examples, overview of processes involved from discovery to consumption, Petroleum industry value chain, Associated team players in petroleum and gas industry operations Opportunities available to the petroleum and Gas Engineers.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 202: Engineering Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four ‘athletes’: geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;

5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and

6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,

5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development;

coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student’s major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

GNG 203: Rock and Fluid Properties (2 Units C: LH 15 PH 45)

Learning Outcome

At the end of this course, the students should be able to:

1. explain that reservoir rocks are porous and thus be able to make the connection as to how Darcy’s law can then be used to discuss the concept of permeability and relative permeability or reservoir rock;
2. describe the effect of surface tension and wettability on the phenomenon of capillarity movement of fluid through the pores of reservoir rock; and
3. explain thermodynamic behaviour, phase equilibria and reservoir rock fluids.

Course Contents

Composition and porosity of reservoir rock. Darcy’s law and the concept of permeability and relative permeability; capillary phenomena, surface tension forces, wettability, compressibility and static distribution of fluids. Electric conductivity; chemical, physical and thermodynamic properties of underground fluid. Gas laws, behavior of liquid, phase equilibrium, Viscosities of hydrocarbons, uses of fluid properties in reservoir engineering, rock and fluid property correlation.

Laboratory

The laboratory section is based on materials covered in this course, including coring and core analysis, determination of petrophysical properties, such as porosity, permeability, water saturation and gas formation volume factor.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;

8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies)

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:
1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;

2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 306: Renewable Energy Systems and Technology (3 units C: LH 30 PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,

4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
1. design of machine components;
2. product design and innovation;
3. part modelling and drafting in solidworks; and
4. technical report writing.

PNG 308: Drilling and Well Design I (**3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to**:**
1. explain bit selection and its evaluation of the bits ability to drill through reservoir rock by considering bit tooth wear on bit bearings and how to terminate the bit run;
2. demonstrate understanding of the fundamentals of oil well drilling, especially the techniques employed for oil well completion; and

3. plan a drilling operation to include cost estimation, assemblage of a drilling team, rigs and rig power systems, hoisting.

Course Contents
Introduction to drilling engineering. Fundamental concepts in oil well drilling. Well planning and cost estimation. Drilling team, drilling rigs, rig power system, hoisting system, circulation system, the rotary system, the well control system, well-monitoring system, special marine equipment, drilling cost analysis, and bit types available. Rock failure mechanisms. Bit selection and evaluation. Factors affecting tooth wear, bearings wear and terminating a bit run. Factors affecting penetration rate, bit operation, drilling fluids and drilling hydraulics, and well head equipment.

Laboratory
The laboratory section includes determination of rheological properties of drilling fluids.

PNG 310: Fundamentals of Reservoir Engineering (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain how to undertake the characterisation of a petroleum reservoir;
2. perform an in-situ-evaluation of the hydrocarbon stock in the oil and gas before gathering;
3. recommend ways to recover the hydrocarbons;
4. perform the material balance calculation required in water influx-models and be able to apply fluid flow concepts to recover their hydrocarbons from the oil well; and
5. explain what a decline curve analysis is used for in the applications of Darcy's law to well formations and reservoir rocks.

Course Contents
Introduction: Functions of a reservoir engineer. Characteristics of petroleum reservoir; geological concepts in reservoir engineering; recovery methods and definitions of reservoirs. Determination of hydrocarbon in-place for oil and gas recovery: volumetric methods; material balance and applications; water influx models and calculations; uncertainties in reserve calculations. Fluid flow concepts; flow potential; Darcy's Law. Decline curve analysis.

PNG 312: Oil and Gas Production Engineering I (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to**:**
1. demonstrate an overview knowledge of subsurface and surface production operations;
2. explain how pressure differential is used to analyse the flow of fluid at various points from the oil and gas reservoir to the surface;
3. relate how to apply Darcy's law in solving reservoir to sand face flow problems, solve problems of vertical pipe flow and flow through surface restrictions (chokes);
4. state how to diagnose well problems and proffer technical solutions;
5. describe the concept of workover;
6. explain the possible actions to be taken to optimise production and the principles of well stimulation methods; and
7. state how the various pressure maintenance methods work.

Course Contents

Introduction to Petroleum Engineering: Subsurface and surface operations. Operational functions and output of subsurface production engineer. Nodal analysis in flow and outflow performances: governing equations, inflow performance relationship (IPR), productivity index, formation damage, fines migration and skin effect, vertical lift well head equipment performance and pressure losses, and choke performance. Problem wells analysis: sand, water, hydrate, scale, unstable flow, surge, waxy crude production, etc. Well surveillance. Well stimulation: fracturing and acidising. Introduction to artificial lift methods. Gas lift and pumping system.

GNG 316: Natural Gas Utilisation and Monetisation Concepts (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. employ gas technology in acoustic and combustion engineering;
2. design furnace and burners for gas combustion;
3. explain the various processes involved in the conversion or use of gas either as a fuel or as an ingredient (raw material) in the following industries:
    - Petrochemical, cement, paper and pulp
    - Fertilizer, power plants and air-conditioning
    - Medical equipment/anesthetics
    - Processes of gas utilisation in the industries above;
4. calculate waste heat and develop waste heat recovery programmes in plants;
5. explain domestic gas utilisation in the areas of cooking/heating/drying; and
6. highlight the effects and significance of gas prices on gas utilization/monetization.

Course Contents

Fundamental technologies and engineering aspects of industrial gas utilisation. Relevant aspects of fluid dynamics, heat transfer, combustion and acoustics. Technology of industrial gas utilisation, including refractory materials, burner and furnace design, safety, measurement and control. Gas utilisation in the following industries: glass, aluminium, steel, fertilizer, petrochemicals, cement, paper and pulp, power plants, drying and air conditioning. Temperature control of furnaces; waste heat recovery; efficiency of furnaces. Domestic gas utilisation. Effects of gas prices, characteristics and quality. Emphasis will be laid on safety and control.

400 level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation; and

4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them;
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

GNG 405: Natural Gas Reservoir Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to**:**

1. describe gas properties and reservoir systems;
2. apply gas recovery techniques;
3. explain how to analyse reservoirs for associate and non-associate gas; and
2. discuss the recovery of gas condensation through water influx theory.

Course Contents

Properties of gases. Gas reservoir system. Gas recovery. Associated and non-associated gas reservoir analysis. A study of gas-condensate and under-saturated reservoir including recovery methods and recovery factor. Water influx theory as applicable to gas recovery. Material balance equation.

GNG 407: Gas to Power Generation and Emission Management
(2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to**:**

1. explain the basic testing methods for determining the distribution of particulate matter in air and gaseous emissions, combustion emissions for solid, liquid and gaseous fuel wastes;
2. highlight the basic thermodynamics of the steam cycle, gas turbine cycle, the cycles of Rankine and OHO engines; and
3. design cooling towers.

Course Contents

Basic thermodynamics, steam power cycles, gas turbine cycles and combined cycles, cooling towers and condensers, ideal engines cycles, refrigeration and heat pumps. Industrial air pollution monitoring particulate and gaseous emissions. Combustion and emission calculations for solid, liquid and gaseous fuels or wastes

GNG 409: Natural Gas Process Plant Design (3 Units E: LH45)

Learning Outcomes

At the end of this course, the students should be able to:

1. develop energy and material balance for the flow sheets;
2. simulate the design of gathering facilities in which contactors, separators, heat exchangers and storage tanks may be needed; and
3. explain the need for determining the net pump suction head for pumps and the power requirement of gas compressors as they relate to the gathering facility.

Course Contents

Process flow sheet. Material and energy balance. Design of valves. Gas gathering systems simulation and design. Design of contactors, separators, heat exchangers and storage tanks. Design of gas compressors and other allied equipment. Simple design projects. Software application.

GNG 413: Natural Gas Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss the compressive flow of gases in pipes as gases are transported through pipelines;
2. describe the compression in the design of compressors;
3. evaluate well performance by being able to estimate gas reserves by conventional and unconventional means;
4. handle the sour gas problem by suggesting various gas treating methods; and
5. design gas storage facility.

Course Contents

Production and transportation of gas: gas flow in pipes and compression. Well performance. Estimation of gas reserves (conventional and unconventional). Field handling of natural Gas. Sour gas problems. Gas condensate fields and storage of gas. Production from both conventional and unconventional sources.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

GNG 504: Natural Gas Reservoir Modelling and Simulation (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the basic principles of reservoir modelling;
2. perform basic modelling of hydrocarbon reservoirs from the knowledge of the basic principles in 1 above;
3. comprehend and apply the numerical methods applied in reservoir modelling;
4. perform simulation studies leveraging reservoir rock and fluid and production data; and

5. conduct history matching and production forecast using real life data.

Course Contents

Basic principles of reservoir modelling. Modelling gas, oil and gas condensate reservoir. Numerical techniques (finite difference method, finite element, method of weighted residuals.). Setting up a simulation study, data collection, fluid properties. History matching, performance prediction, case studies, specialised applications, water flooding, gas cycling, infill drilling and miscible flooding.

GNG 511: Natural Gas Technology Process Control (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. acquire a working know-how of programmable logic controllers and distributed control systems;
2. explain the basics of controller action on centrifugal and reciprocating compressor;
3. engage in control room management exercises and training programs;
4. institute a maintenance program and trouble-shooting exercise for handling controller difficulties; and
5. develop mathematical models for process dynamic systems as lumped or distributed parameter systems as they apply to feedback control systems.

GNG 513: Offshore Gas Production and Flow Assurance (Production III) (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the working operation of a production platform;
2. discuss the challenges they face during production and how the problems are solved;
3. explain subsea well completion methods and carry out completion designs;
4. know the various offshore processing equipment and perform relevant equipment design;
5. explain offshore loading and transportation systems;
6. discuss the principle of operations of multiphase pumping and metering systems relevant to offshore gas production operations;
7. explain offshore logistics and contingencies in gas production operations;
8. discuss the effect of offshore gas operations on the environment and proffer insightful remedy where necessary;
9. explain the various measures of corrosion control in offshore gas production operations; and
10. comprehend the challenges facing flow of gas through pipes and apply necessary flow assurance mechanisms.

Course Contents

Offshore production. Sub-sea well completion methods; offshore processing equipment and design; loading systems and other transportation; multiphase pumping and metering. Offshore operations; logistics and contingency planning; environmental considerations; oil spill and oil removal; corrosion control. Flow assurance challenges, prediction and management; hydrates formation; scale; erosion.

Minimum Academic Standards
Equipment
List of Laboratory Equipment in Fluid and Cement Laboratory

1. Mixers and cups
2. Marsh funnels
3. Direct indication viscometers
4. Consistometer
5. Pressure filter press
6. Constant temperature water bath
7. Roller oven
8. Standard API sand sieve
9. Retort kit
10. Resistivity meter
11. Mud rheometers
12. pH meters
13. Mud balance
14. Chemical balance
15. Standard filter press
16. Filter papers
17. Bentonite, barytes and mud additives (chemicals)
18. Cement analyzer

List of PVT Laboratory Equipment

1. Visual PVT cell
2. Recombination cell
3. Oil molecular weight tester (Cryette Cryoscope)
4. Multi-stage flash separator
5. Gasometer
6. Digital density meter
7. High pressure high temperature density meter (Pycnometer)
8. Electromagnet viscometer or rolling ball viscometer
9. Gas cylinder
10. Oil cylinder
11. Gas chromatograph (with all support gases such as hydrogen, air and helium) for gas analysis
12. Gas chromatograph (with all support gases such as hydrogen, air and helium) for liquid analysis
13. Positive displacement pump
14. PVT surface sampling kits
15. Pressure generator system
16. Sample restoration apparatus
17. Weight balance

Other Accessories in the PVT Laboratory

1. Heating mantle
2. UPS
3. Digital pressure gauge
4. Piping materials for gas chromatograph installation

Core Analysis and Reservoir Engineering Laboratory

S/N	Equipment	Accessories
1	Resistivity meters tensiometer	
2	Core slabbing crosscut and band saws	
3	Core milling machine	
4	Core preservation system	Refrigerator, wax bath and core trays
5	Dean stark equipment	
6	Distillation assembly	Compressor
7	Porosimeters	Nitrogen cylinder/gas
8	Core cleaner (Soxhlet extractor)	Heating mantle, oven
9	Centrifugal extractor	
10	High pressure saturator	
11	Capillary pressure test equipment	
12	Refractometer	
13	Liquid and gas permeameters	Nitrogen cylinder/gas
14	Planimeter	
	Other Equipment	
15	Core trimming/cutting machine	
16	CT scanner	
17	Gamma ray logging machine	
18	Digital core photography camera	
19	Humidity and conventional oven	
20	Particle size analyzer	
21	Retort oven	
22	Miniature core flooding system	Compressor nitrogen cylinder/gas
23	Amott cell	

Production Laboratory

1. Viscosimeters
2. Hydrometers
3. Corrosion test kits
4. Flow meter rig
5. Centrifuge

Computer Laboratory

The computer laboratory should have at least 40 PCs with at least one of the following software installed.

No.	Area	Software	Purpose
1	Reservoir engineering	MBAL	Material balance calculation/Decline curve analysis
2	Reservoir engineering	ECLIPSE	Dynamic simulation
3	Production	PROSPER	Nodal analysis, stimulation and gaslift Design

4	Formation evaluation	TECHLOG	Petrophysical evaluation
5	Geology	PETREL	Seismic and 3-D modeling
6	Economics	CYSTAL BALL	Economic evaluation
7	Field Development	QUESTOR	Cost estimation and development concept selection
8	Plant Design	Aspen hysys	Process plant design for gas dehydration etc.

Other Requirements for Training of Students

1. CD/DVD players
2. LCD screens
3. Projectors
4. Wireless speakers
5. Audio CDs, tapes, etc., on Petroleum Engineering courses
6. Some disused oil field equipment like stabilizers, centralisers, drilling bits, well head assembly, gas lift mandrels, etc.
7. Demonstration rigs
8. Demonstration flow stations

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC:
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, and standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices

Academic and Non-Academic Spaces

The NUC recommends the following physical space requirements:

Academic	**m^2**
Professor's office	18.50
Head of Department's office	18.50
Tutorial teaching staff space	13.50
Other teaching staff space	7.00
Technical staff space	7.00
Science staff research laboratory	16.50
Engineering staff research laboratory	14.50
Seminar space per student	1.85
Drawing office space (A.O. board) (Per student)	4.60
Drawing office space (A.I. board) (Per student)	3.70
Laboratory space	7.50
Non-Academic	
Secretarial space	7.00

Office Accommodation

The requirements for office accommodation are:

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves and computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves and computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet and bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet and bookshelves

B.Eng. Petrochemical Engineering

Overview

Petrochemical Engineering applies basic principles in chemical and physical sciences to the development, design, fabrication and construction, operation, control, and management of plants for the processing of raw materials from petroleum and organic sources to obtain useful products (chemicals, solvents, adhesives, detergents, plastics, polymers and fibers, lubricants, fertilizers) for human consumption. Petrochemical Engineering course includes subjects like Reaction Engineering, Heat Transfer, Mass Transfer, Fluid Dynamics, Thermodynamics, Transport Phenomena are bridged with special subjects like Petrochemical Processes, Refinery operations with due weight-age on Numerical Computation, Process Control, Modeling & Simulation.

Philosophy

The curriculum is designed to prepare the graduates to launch their careers in Nigeria and overseas. The program is therefore designed to impart sound knowledge in students in both practical and theoretical senses so that the students can apply related principles from the sciences in designing equipment and manufacturing of products in a petrochemical plant, in manufacturing, and oil and gas companies.

Objectives

It is expected that on successful completion of the programme, the graduates of the Petrochemical Engineering program should be able to:

1. apply the basic principles underlying the operation of Petrochemical Engineering plants, and processes that occur in the system plants;
2. design, fabricate, model, simulate and optimise chemical technological processes and further prepare and read engineering drawings and technological schemes;
3. set up and operate small-scale units of their own so that they can be self-employed;
4. operate, maintain and service Petrochemical Engineering plants;and
5. work safely without hazards and control pollution in any environment.

Employability skills

The program is designed so that graduates from this program can have good employment opportunities in the following areas:

1. petroleum industry
2. petroleum refineries
3. petrochemical plants
4. soap and detergent industries
5. plastic processing plants
6. pharmaceutical industries
7. research organizations
8. technical sales
9. engineering consultancy
10. environmental consultancy

It is also intended that graduates of this program will be adequately skilled to be able to:

1. analyse complex engineering problems, reaching substantiated conclusions by using first principles of mathematics, natural sciences, and engineering sciences;

2. practise engineering design and apply knowledge to design solutions, systems, components, and processes to meet specified requirements efficiently;
3. execute experimental work effectively, as an individual or in a team in multifaceted and /or multidisciplinary settings;
4. communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and the society at large, such as being able to comprehend and write effective reports and do documentation, make effective presentations, and give and receive clear instructions;
5. demonstrate management skills and apply engineering principles to their work, as a member and/or leader in a team, and manage projects in a multidisciplinary environment;
6. apply the fundamentals of petrochemical plant design manually and with software;
7. design and prepare an assessment of the economic performance of the proposed plant; and
8. use modern software to analyse and design Petrochemical Engineering processes.

21st Century Skills

In addition to the sound theoretical concept, the curriculum for CCMAS in Petrochemical Engineering seeks to emphasize the 21st Century skills in the use of:

1. creativity and innovation;
2. artificial intelligence (AI);
3. critical thinking/problem solving/decision making;
4. collaboration (teamwork and ethic);
5. communication;
6. learning to learn/metacognition
7. information literacy; and
8. computational thinking.

Unique Features of the Programme

This programme was compared with the COREN BMAS 2017 and programmes of top global universities in Petrochemical Engineering at the undergraduate level, noting however that most universities only offer Petrochemical Engineering at the postgraduate level in the UK and USA.

The following changes make the program unique:
1. Petroleum Economics & Engineering Management replaced with Engineering Economics & Management to give room for more petrochemical courses;
2. Core Petrochemical Engineering courses were added to the new curriculum at 300-500-levels because the old NUC BMAS reflected more Petroleum Engineering courses;
3. The software required by the students which are relevant to the petrochemical industry were included, and time was allocated on the course structure to teach them alongside the courses that require the use of software;
4. The final year project was divided into 1unit in the first semester (seminar: defence of Chapter 1-3 and 6units in the second semester (completion of the project and final defence);
5. inclusion of animation laboratory where students can watch animation videos (on several petrochemical plants such as production of polymers, fuel blending, pyrolysis of seeds to fuel oil. Ethylene glycol, ethylene acetate, production of sulphuric, phosphoric fertilizers; production of gasoline, naphtha, kerosene, fuel, and lubricating oils, paraffin wax, asphalt etc.), during their Year 3 SIWES II and write reports on some of them and defend them;

6. inclusion of LabView software on the PCs (LABVIEW Stands for Laboratory Virtual Instrumentation Engineering Workbench). It is mostly used for automating the usage of processing and measuring equipment in all the laboratory setups. It is used in the field of Industrial automation, Instrument control, data acquisition, among others);
7. It is expected that 2hrs every week should be used by students to learn how to use software such as Microsoft Excel, POLYMATH, MATLAB, ASPEN HYSYS, ASPEN PLUS, CHEMCAD, Scilab etc. to do simple calculations based on the course content of these courses in the program; and
8. Knowledge of Artificial Neural Network software and DATAFIT for process optimisation was included.

Admission and Graduation Requirements

Admission Requirement

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry(DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**GST/ENT**	**Basic Science**	**Faculty (GET)**	**Department (PCE)**	**SIWES**	**Total**
100	4	16	3	02		25
200	4		14	02	3	23
300	4		10	10	4	28
400			-	04	8	12
500			5	12		17
Total CCMAS	**12**	**16**	**32**	**30**	**15***	**105**

* All 15 units of SIWES to be credited in the 2^{nd} Semester of the 400-Level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian people's and culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineering in Society	1	C	15	
GET 102	Engineering Graphics and solid works I	2	C	15	45
PCE 112	Introduction to Petrochemical Engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and innovation	2	C	30	-
GET 204	Students workshop experience	2	C	15	45
GET 206	Fundamentals of thermodynamics	3	C	45	-
GET 209	Engineering mathematics I	3	C	45	-
GET 210	Engineering mathematics II	3	C	45	-
GET 211	Computing and software engineering	3	C	30	45
*GET 299	SIWES I: SWEP	3	C	9 weeks	
PCE 201	Introduction to petro-chemical engineering calculations	2	C	30	30
	Total	**20**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and conflict resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Engineering Communication and Technical Writing	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
*GET 399	SIWES II: Supervised Industrial Work Experience	4	C	12 weeks	
PCE 301	Chemical Thermodynamics	2	C	30	
PCE 302	Chemical Reaction Kinetics and catalysis	2	C	30	-
PCE 303	Unit Operations of Petrochemical Engineering plant I	2	C	30	-
PCE 304	Unit Operations in Petrochemical plant II	2	C	30	-
PCE 305	Fundamentals of Petroleum Engineering	2	E	30	-
PCE 306	Petrochemical Engineering Laboratory I	1	E	-	45
	Total	**24**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
PCE 401	Petroleum Refining	2	C	30	-
PCE 403	Petrochemical Engineering Process Analysis	2	C	30	-
PCE 405	Instrumentation and Process Control in Petrochemical Plant	2	E	30	-
PCE 407	Chemical Reaction Engineering in Petrochemical plant 1	2	E	30	-
PCE 409	Heat and Mass Transfer	2	E	30	
PCE 411	Process Design of Petrochemical Plant I	2	E	30	-
PCE 413	Petrochemical Engineering Laboratory III	1	E	-	45
*GET 499	SIWES III (6 months in a Petrochemical plant)	8	C	24 weeks	
	Total	**4**			

Note:

It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the contents of these courses

***SIWES Courses**

Course Code	Course Title	Units	Status	LH	PH
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24weeks	
	Total	**15**			

***** All SIWES to be credited in the 2nd Semester of 400-level.

500 Level

Course Cod	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	R	30	-
PCE 501	Petrochemical & Organic Synthesis I	2	C	15	45
PCE 502	Process Design in Petrochemical plant II	3	E	45	-
PCE 503	Chemical Reaction	2	C	30	-

	Engineering in Petrochemical plant II				
PCE 504	Petrochemical and Organic Synthesis II	2	C	30	-
PCE 505	Research Methods and Seminar	1	C	-	45
PCE 506	Final Year Project	3	C	-	130
PCE 507	Process Dynamics and control in Petrochemical plant	2	C	30	-
	Total	**17**			

Note:

It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the contents of these courses

It is expected that 2hrs every week should be used by students to learn how to use modelling software such as MATLAB, POLYMATH, microsoft excel etc, for simple calculations based on the contents of these courses.

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria;
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and

10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;

5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;

5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PCE 112: Introduction to Petrochemical Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify a petrochemical plant and explain the functions of the petrochemical engineer in the plant;
2. identify facilities in petrochemical plant, draw simple petrochemical process flow charts and process symbols;
3. apply the concept of units and dimensions, measurement and apply them in different systems;
4. analyses pressure, temperature, volume data; and
5. carry out simple calculations on ideal gas laws, real gas relationships, vapour pressure, saturation, and humidity, chemical equations and stoichiometry, andcombustion reactions.

Course Contents

Description of petrochemical plant and a petrochemical engineer. Raw materials for the petrochemical industry and examples of petrochemicals; the importance of petrochemical to the nation. Ancillary facilities in petrochemical plant; Petrochemical Engineering process flow charts, and process symbols. The concept of units and dimensions: the concept and basis of measurement and analysis of pressure, temperature, volume, and other parameters. Basic definitions: chemical equations and stoichiometry. Combustion. Ideal gas laws. Real gas relationships. Vapour pressure, saturation, and humidity.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume;

temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types; 3. numerically solve differential equations using MATLAB and other emerging applications;
3. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
4. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
5. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
6. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units: C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Content
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

PCE 201: Introduction to Petrochemical Engineering Calculations
(2 Units C: LH 30; PH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. formulate and solve closed steady-state material balances on multi-stage systems with and without a recycle and purge;
2. formulate and solve closed steady-state material balances on multi-stage systems that include single and multiple chemical reactions;
3. formulate and solve closed steady-state material balances on multi-stage systems that include complete and incomplete conversions;
4. formulate and solve problems involving species and elements for reacting and non-reacting systems;
5. formulate and solve Energy balances; and
6. formulate and solve combined material and energy balances for simple petrochemical units.

It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the content of this course.

Course contents

Analysis of material balances for multiple systems. Analysis of material balances problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed systems. Problems involving species and elements for reacting and non-reacting systems. Material balances in process flow sheets. Energy balances procedures, energy balances for reactive and non-reactive processes, heat capacity. Calculation and enthalpy changes, without change of phase and for phase transitions. The heat of reaction combined mass and energy systems for steady-state and unsteady-state processes. Computer-aided combined mass and energy balance calculations.

300 Level

GST 312: Peace and Conflict Resolution **(2 Units C: LH 30)**

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and

5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and

modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles

of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes
At the completion of the course, the students are expected to be able:
1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;

2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of "ai".; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python "ai" libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
1. design of machine components;
2. product design and innovation;
3. part modelling and drafting in SolidWorks; and
4. technical report writing.

PCE 301: Chemical Thermodynamics (2 Units C: LH 30)

Learning outcomes
At the end of this course, the students should be able to:
1. apply first, second and third law to ideal and real gases;
2. calculate heat requirements for reacting and non-reacting systems;
3. apply the concept of fugacity and its application to processes; and
4. apply thermodynamic principles to chemical, phase equilibrium, and electrochemical processes.

Course Contents
First law and the energetics of chemical reactions. Second law, calculation of entropy changes. Definitions of thermodynamic potentials. Heat of mixing. Fugacity, free energy and work function. Chemical potentials and affinity of reactions. Equilibrium in chemical reaction systems. Equilibrium constant of a reaction. Third law. Thermal data. thermodynamics of electrochemical cells. Work production from chemically reacting systems. Phase relations and thermodynamics of solutions. Equilibrium in heterogeneous reactions.

PCE 302: Chemical Reaction Kinetics and Catalysis (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. develop rate expressions for different chemical reactors;
2. determine reaction order and activation energy;

3. apply the theories of reaction rates and their application to petrochemical processes; and
4. formulate the different catalytic reactions, their kinetics and applications in petrochemical processes;

* It is expected that 2hrs every week should be used by the students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the contents of this course

Course Contents

Rate expressions for chemical reactions law of mass action. Constant volume reversible, irreversible, parallel and consecutive reactions. Reaction order and its determination. Variable volume reactions Arrhenius equation and activation energy. The theories of reaction rates, especially the collision theory and theory of absolute reaction rates. Homogeneous and heterogeneous catalytic reactions and their kinetics. Kinetics of electrochemical processes. Equilibria in ionic solutions.

PCE 303: Unit Operations Petrochemical Plant I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the principles of separation processes;
2. explain the characteristics, applications and rating problems relative to the unit operations mentioned in the course content for steady and unsteady state, batch and continuous, stage- continuous contact operations;
3. discuss the regimes for the flow in tubes and pipes, Bernoulli's equation, pressure drops, pumps, elements of external flow (Stokes' and Newton's law); and
4. apply the different methods of solid-liquid separation using the units’ operations listed in the course content;

* It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the content of this course.

Course Contents

The basic concept of unit operations in a petrochemical plant. Elementary technological review of the importance of unit operations in the chemical industry. Steady and unsteady state, batch and continuous, stage- continuous contact operations. Size reduction. Types of crushers, their operation and theory of design. Particle classification/drag forces on rigid bodies, drag coefficients, setting velocity and Stoke’s law. Classification of solids. Centrifugal separation. Cyclones and centrifuges. Electrical separation. Mixing of solids and fluids. Filtration. Packed and fluidised bed systems; their applications. Drying and humidification.

PCE 304: Unit Operations in Petrochemical plant II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the student should be able to:

1. explain and analyse vapor-liquid equilibria;
2. construct vapor-liquid equilibrium curves;
3. explain and analyse distillation process; and
4. prepare material balance for single, flash and binary multistage distillation column;
5. calculate ideal equilibrium stage for binary mixtures using different methods;

6. carry out bubble and dew point calculations for multicomponent mixtures;
7. explain and analyse liquid-liquid equilibria;
8. solve problems involving single-stage liquid-liquid equilibrium extraction;
9. solve problems involving continuous multistage counter-current liquid-liquid extraction and leaching; and
10. discuss and apply the theory of crystallization in mono-and multi-systems, crystal growth, dialysis, and reverse osmosis.

* It is expected that 2hrs every week should be used by the students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the content of this course.

Course Contents
Vapour-liquid equilibrium and distillation. Distillation equipment. Multicomponent distillation. Vacuum distillation and steam stripping. Azeotropic and extraction distillation. Liquid-liquid extraction, leaching, theory of crystallization in mono-and multi-systems. Crystal growth. Dialysis. Reverse osmosis.

PCE 305: Fundamentals of Petroleum Engineering (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be to:
1. discuss exploration methods, drilling rigs, bits, and fluids;
2. explain on-shore and off-shore drilling processes;
3. explicate well completion, logging and production.
4. test the quality of petroleum products; and
5. elucidate store and transport petroleum products.

Course Contents
Origin and occurrence of petroleum and gas. Oil exploration methods. Drilling rigs and drilling bits. Blow out preventers and drilling fluids. Finishing techniques. On-shore and Off-shore drillings. Well completion. Logging. Petroleum production. The secondary method of petroleum recovery; surface operations in petroleum production. Stabilisation of petroleum. Oil, gas and water separation. Basic tests on petroleum quality. Petroleum transportation and storage.

PCE 306: Petrochemical Engineering Laboratory I (1 Units E: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. work safely in the laboratory and write reports on all the experiments the students carried out in the lab; and
2. apply and explain the importance of all the experiments carried out in the lab listed in the course content in the Petrochemical industry.

Course Contents
Safety precautions and experimental report writing. Analysis of Experimental Error in Research and Data Presentation; particle distribution and sieve analysis; density, specific gravity, pH measurement in different solutions. Sampling of solids; determination of flash point of petroleum and fuel oil and related materials. Determination of viscosity of petroleum and fuel oil using redwood viscometer. Determination of particle and bulk density. Determination of pour points of petroleum products and related materials. Measurement of

molecular weight; refractive index using Abbey refractometer; ASTM Distillation; aniline point determination; the Nitrogen content of soil, water and other materials. Softening point of bitumen and petroleum products. Measurement of surface tension and Reid vapour pressure. Evaporation and boiling point and simple distillation processes.

PCE 307: Petrochemical Engineering Laboratory II (1 Units C: PH 45)

Learning Outcome

At the end of this course, the students should be able to:

1. work safely in the laboratory and write reports on all the experiments carried out in the lab; and
2. demonstrate the importance and applications of all the experiments carried out in the lab listed in the course content above to the petrochemical industry.

Course Contents

Pressure drops in pipes. Sedimentation and thickening. Filtration, crushing, grinding and mixing. Batch heating of the liquid in tanks. Leaching, liquid-liquid extraction, drying, desorption and adsorption, integral and differential methods of analysis of laboratory kinetic data. Application of half-life method for determination of reaction order and rate constant. Heterogeneous reaction: cation and anion exchange capacity

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

PCE 401: Petroleum Refining I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate how a petroleum refinery works and sketch a flow diagram that integrates all refining processes and the resulting refinery products;
2. examine how each refinery process works and how physical and chemical principles are applied to achieve the objectives of each refinery process listed in the course content;
3. produce grease and bitumen; and
4. enumerate the safety rules and combat environmental issues in the refinery.

Course Contents

Catalytic cracking and hydrocracking. Lubricating oil properties. Manufacture of lubricating oils. De-asphalting, phenol and furfural extraction, dewaxing, clay treatment and hydro-finishing processes. Grease production. Refinery layout. Safety rules. Environmental protection in the petroleum refinery. Manufacture of bitumen.

PCE 403: Petrochemical Engineering Process Analysis, and Optimization (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. apply mathematical methods in solving problems involving Petrochemical Engineering processes listed in the course content;
2. apply numerical methods in solving problems involving Petrochemical Engineering processes listed in the course content;
3. describe optimization theory and its applications to petrochemical processes;
4. model material and energy flows around reacting and non-reacting systems using an appropriate modelling software package;
5. define and solve engineering problems and formulate suitable strategies for problem solutions; and
6. Apply knowledge of Artificial Neural Network software and DATAFIT in process optimization.

* It is expected that 2hrs every week should be used by the students to learn how to use software such as Microsoft excel, POLYMATH, (MATLAB is a computing language and interactive environment for data visualisation, algorithm development, data analysis, and full of numeric computation) for simple calculations based on the content of this course.

Course Contents

Review of elementary theorems and operations on vectors and matrices. Application to Petrochemical Engineering stage processes including rectification, multicomponent distillation, staged absorbers, complex monomolecular kinetics, stirred tanks reactions and stage dynamics. Review of solutions of the standard form of differential equations including series solutions. Green's functions. Formulation of simple and complex chemical engineering problems and their solutions. Numerical methods for solving linear and non-linear equations, ordinary and partial differential equations. Iterative procedures. Optimization techniques.

PCE 405: Instrumentation and Process Control in Petrochemical plant
(2 Units E: LH 30)

Learning outcomes:
At the end of this course, the students should be able to:
1. explain the basic principles and importance of process control in industrial process plants;
2. specify the required instrumentation and final elements to ensure that well-tuned control is achieved;
3. explain the use of block diagrams and the mathematical basis for the design of control systems;
4. explain different control modes and their application in controlling various processes;
5. explain the working of electric, hydraulic and pneumatic controllers;
6. demonstrate the workings and application of the different types of actuators and control valves;
7. explain the importance and application of good instrumentation for efficient design of process control loops for process engineering plants; and
8. draw a PID (Process and Instrumentation Diagram) and devise simple but effective plant wide control strategies using appropriate heuristics.

* The students should learn how to use instrumentation software, (LABVIEW, PDMS) Scilab (is a numerical computation package that is very important in instrumentation and control engineering.) to solve problems exposed to them in the course content.

Course Contents
Process measurement. Pressure, force, level, flow, temperature, humidity density, viscosity. Primary element calibration. Signals nozzles, baffle and relay principles, balancing principles. Transmitters. Controller and valve actions and mechanisms. Control responses: on-off, proportional, automatic, reset, pre-act, 3-ter, gap control. Automatic controllers and inter-linked instruments. Concept of control loops. Ratio, Cascade, spilt range, override, and point, time cycle and forward feed controllers. Instrument error and recognition of faults.

PCE 407: Chemical Reaction Engineering in Petrochemical plant I
(2 Units E: LH 30)
Learning Outcomes:
At the end of this course, the students should be able to:
1. calculate conversion and extent values for different systems;
2. calculates extent and conversion values for constant volume systems;
3. develop performance equations for different types of reactors listed above using mass balances;
4. develop chemical reaction kinetics equations for different reactors and apply it to some Petrochemical plants;
5. develop design equations for reactors listed above; and
6. generate reaction constants.

* It is expected that 2hrs very week should be used by students to learn how to use software such as CHEMCAD, ASPEN HYSYS for simple calculations based on the content of this course.

Course Contents
Classification of reactors. Chemical kinetics as applied to batch and continuous reactors a single ideal reactor. Steady-state mixed and plugs flow reactors. Holding time for flow systems. Design equations for single conversion of the reactor. The batch reactor, mixed versus plug flow reactors. Reactors in series and in parallel Recycle reactors.

PCE 409: Heat and Mass transfer (Transport Phenomena) (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. enumerate the modes of heat transfer and their applications;
2. apply heat and mass transfer principles to steady-state and, unsteady-state processes;
3. determine overall transfer coefficient;
4. apply heat and mass transfer principles to heat exchangers, conductors and dryer; and
5. differentiate between heat, mass and momentum.

Course Contents
Basic laws of heat and mass transfer processes, and their relationships. Models of heat transfer, general heat conduction equation, steady-state conduction, unsteady heat transfer by convection, natural and forced, laminar and turbulent. Heat transfer by radiation, fundamentals of black and Gray bodies, combined models of heat transfer, radiation exchange between surfaces. Applications to heat exchangers, conductors and dryers. Dimensional analysis and heat transfer by convection. Analogy between heat, mass transfer. Reynold's analogy. Chilton–Colburn analogy. Analogy between heat, mass and momentum, measurement, calculation and production of heat and mass transfer coefficients. Mass transfer fundamentals, diffusion and convection mass transfer. steady-state and unsteady mass transfer

PCE 411: Process Design of Petrochemical plant I (2 Units E: LH 30)

Learning outcomes
At the end of this course, the students should be able to:
1. enumerate the fundamentals of process plant design;
2. carry out material and energy balance of a simple unit manually and using Computer software packages;
3. apply the criteria and procedures for equipment selection and sizing in design of distillation, absorber, adsorption column;
4. prepare a comprehensive basic engineering design report manually and use computer software packages;
5. design and prepare an assessment of the economic performance of the Petrochemical plant manually and use computer software packages; and
6. carry out the mechanical design of columns including foundation and supporting structures.

* It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS to do simple Calculations based on the content of this course.

Course Contents
The general scope of design. Factors influencing the cost of products. Process evaluation. Block diagrams. Mass and energy balances. Process flowsheets. Flowsheet symbols, engineering flowsheets symbols, engineering flowsheets, mechanical flow diagram, utility flowsheets. Presentation and discussion of real design problems. Design codes and standards, design information and databases. Computer software packages (Aspen Hysys, PV Elite, Chem Cad). Selection between packed and plate towers and column internals. Detailed design procedures for distillation, extraction and absorption and costing. the applicability of these methods to vacuum and high-pressure operation. Mechanical design of columns including foundation and supporting structures.

PCE 413: Petrochemical Engineering Laboratory III (1 Unit E: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. demonstrate knowledge and skills regarding HSE in the chemical laboratory;
2. show the importance and applications of all the experiments carried out in the laboratory as listed in the course content;
3. verify theoretical and experimental knowledge by planning and executing experiments in the laboratory; and
4. work both independently and in a group in the laboratory and document the results obtained through writing of laboratory reports.

Course Contents
HSE in the chemical laboratory gas analysis, Maleic Diene value of dry oil. Calibration of instruments. Practical demonstration of a control loop for pneumatic and electronic instrumentation. Vapour-Liquid equilibrium. Continuous (rectification) distillation crystallization. Determination of saponification and unsaponification matter in fats. Solubility of solids. Absorption using Packed column. Fluidization Engineering, film and drop condensate. Heat exchangers.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change

management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

PCE 501: Petrochemicals and Organic Synthesis I (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. apply fundamental skills in performing synthesis of organic compounds listed in the course content above;
2. apply fundamental skills in the isolation and purification of products of organic synthesis reactions listed in the course content above;
3. can prepare a flow diagram and identify critical/important points in an organic synthesis procedure of the process listed above; and
4. can prepare reaction schemes using the appropriate software.

Course Contents

Raw materials and their processing techniques for ethylene, acetylene, synthesis gas, and liquid hydrocarbons; properties of olefins, thermo-dynamic stability of hydrocarbons, olefin production; use of polymerization reactions, raw materials from aromatic hydrocarbon, chlorination, nitration, oxidation, hydrogenation aromatization, isomerization reactions. Synthesis on basis of acetylene, carbon monoxide, and synthesis gas.

PCE 502: Process Design of Petrochemical plants II (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. manually design and scale-up jacketed vessels and shell-and-tube heat exchangers;
2. use pinch analysis to targeting minimum energy requirement for a process;
3. design heat exchanger networks with minimum energy target;
4. use computer-aided process design;
5. scale-up pumps and pipe networks
6. design and carry out plant layouts using computer software; and
7. design in group simple petrochemical plant with manual and computer software;

* It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, HYSYS for simple calculations based on the content of this course.

Course Contents

Reasons for scale-up and basic principles. Heat exchanger system. Design and scale-up of jacketed vessels and shell-and-tube heat exchangers. Fluid flow system: scale-up of pumps and pipe networks for laminar and turbulent flow Liquid-mixing systems. General principles of scale-up and the use of pilot plant data. Optimization of plant dimensions, operating conditions, and the economics of alternatives. Plant layout of petrochemical plant. Design codes and standards, design information, and databases for heat exchanger designs. Plant Costing. Computer software packages required (ASPEN HYSYS, ASPEN PLUS, PV ELITE).

PRE: PCE 413

PCE 503: Chemical Reaction Engineering II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. calculate conversion for different systems listed above;
2. develop performance equations for different types of reactors above using mass balances;
3. calculates different design parameters for parallel reactions and series reactions;
4. investigate the effect of temperature on reactor design and reaction parameters;
5. calculate enthalpy of reactions using given feed and product specifications;
6. calculate amounts of heat to be supplied or removed from a reactor;
7. develop design equations for reactors listed above;

* It is expected that 2hrs every week should be used by students to learn how to use software such as CHEMCAD, ASPEN, HYSYS, etc, for simple calculations based on the content of this course.

Course Contents

Design for multiple reactions: reactions in parallel and series. Extensions and applications of series-parallel reactions. Temperature and pressure effects. Design of fluid-particle reactors. Chemical reaction control and gas film diffusion control processes. Fluidized bed reactors. Slurry reaction Kinetics. Design of fluid – reactors. Solid catalysed reactors. Design of staged adiabatic packed bed reactors, and fluidised bed reactors. PREG. PCE 409.

PCE 504: Petrochemicals & Organic Synthesis II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. apply fundamental skills in performing synthesis of organic compounds in the course content;
2. apply the fundamental skills in the isolation and purification of products of organic synthesis reactions listed in the course content;
3. prepare a flow diagram and identify critical/important points in an organic synthesis procedure listed in the course content; and
4. prepare reaction schemes using the appropriate software.

Course Contents

Raw materials and their processing techniques for halogenation of paraffins, methane, ethane, olefins, ethylene liquid and gaseous phase halogenation processes. Chlorination products of olefins; methylchloride, synthetic fibers, glue and plastics, vinyl chloride from acetylene, freezers, and antifreezes; hydrolysis, hydration, dehydration esterification processes in the production of solvents, plastification synthetic lubricants, complex organic ethers – monomer for polymerization reactions, oxidation of paraffin and olefins; ethylene oxide and some higher oxides of hydrocarbons synthesis of Amides; condensation of aldehydes with olefins: synthesis of isoprene synthesis of rubber. PREQ PCE 501.

PCE 505: Research Method and Seminar (1 Unit C: PH 45)

Learning Outcomes

At of the end of this course, the students should be able to:

1. define research;
2. enumerate its characteristics and types;
3. explain its process;
4. formulate research problem, objective;
5. construct research tool and questionnaire;
6. analysis data gotten from research for the extraction of useful information for knowledge generation;
7. distinguish between engineering research proposal and other research proposals;
8. cost engineering research proposals;
9. learn how to write and differentiate a proposal and seminar from a research project;
10. write a written report as well as an oral PowerPoint presentation for the purpose of seminar which should be held at the department and for which the students should be graded;
11. write and present the chapter 1-3 of their project on PowerPoint in the first semester; and
12. defend the written and presented chapters.

Course Contents

Definition of research, characteristics of research; types of research; the research process; formulating the research problem; considerations in selecting a research problem; reviewing the literature; procedure for reviewing the literature; formulation of objectives; preparing the research design; consideration for the research design; guidelines to construct a research tool; constructing a questionnaire; piloting the questionnaire; collecting data; ethical issues concerning research participants; ethical issues relating to the researcher; processing and analyzing data; the data processing operations; data analyzing methods; generalization and interpretation of the results; reporting the findings; writing research project report format; general attributes of a research proposal; what distinguishes an engineering research proposal; components of a research proposal; costing an engineering research proposal. The course is designed for final year students who will be required to make seminar presentations. Emphasis here is on how to write an introduction, literature review, methodology, results, and discussion as well as the derivation and/or development of relevant mathematical models and procedures. APA referencing style will also be discussed.

PCE 506: Final Year Project (3 Units C: PH 135)

Learning Outcomes

At the end of this course, the students should be able to:

1. independently design and carry out experimental and correlational research that yields valid results;
2. analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. practice engineering design cycle and apply knowledge to design solutions, systems, components and processes in order to meet specified requirements efficiently;
4. carry out experimental work effectively, as an individual or in a team on multifaceted and/or multidisciplinary settings;
5. communicate effectively, orally as well as in writing, on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations using PowerPoint;
6. demonstrate management skills and apply engineering principles to one’s work, as a member and/or leader in a team;
7. to manage projects in a multidisciplinary environment; and
8. write and present the chapters 1-5 of their projects on PowerPoint in the second semester and defend it before an external examiner.

Course Contents

Individual research project to be supervised by academic staff. The project should focus on solving national and industrial problems. Topics should be given to the students in the first semester but the project when completed should be finally graded in the second semester to enable them to prepare their proposal (chapters 1-3) for technical writing in the first semester.

PCE 507: Process Dynamics and Control of Petrochemical plants
(2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. evaluate models and do an appreciation of their use in chemical engineering;
2. create mathematical models for processes governed by equilibrium, conservation (e.g., mass, momentum, and energy), transport, and kinetic;
3. develop models of representative chemical and/or physical processes from the first principle;
4. discern the difference between steady-state and non-steady-state behavior;
5. demonstrate an appreciation of the importance of dynamics in process design and operation;
6. analyse feed-forward, feed-back, and PID control of systems;
7. analyse the behaviour of linear dynamic systems;
8. show how block diagrams may be used and manipulated to represent relatively complex systems; and
9. use appropriate software tools (e.g., MATLAB Control Toolbox & Simulink) for the modeling of plant dynamics and the design of well-tuned control loops.

* It is expected that 2hrs every week should be used by students to learn how to use software for simple calculations based on the content of this course.

Course Contents

Introduction to process dynamics and control; review of mathematical tools needed for modeling and simulation. Process dynamics: review of Laplace transforms. Transient behavior of I$^{5'}$, $2^{nd,}$ and higher-order systems. Components of a control system; operation and design. Basic control actions, valves. Transfer functions. Use of block diagrams. Systems response to the impulse. Step and sinusoidal inputs. Derivation of dynamics equations for simple instruments-thermometers, liquid level, and manometer. Dynamic equations for control of simple models-mixing vessels, single CSTR and CSTR in series, PFR. Distillation and absorbers columns; Stability analysis/frequency response analysis; design of feedback controllers based on transient response criteria; design of feedback controllers-based on frequency response criteria. Design of model-based controllers such as IMC, DMC etc. Applications of control to petrochemical plants PREG.

Minimum Academic Standards

Equipment

List of Laboratories/Workshops and Some Equipment/ Instruments/ Tools Expected in them

Unit Operation Laboratory

Batch Drying Unit, liquid-solid Rotary Filtration Unit; Spray Dryer, Wetted Disc Absorption Column, Apex Drier, Vacuum Distillation Unit, Double Effect Evaporator, Drying Ovens, Tray Drier Unit, Packed Tower Gas/Liquid Unit. Fluidized Bed Unit Distillation Unit Solid/Liquid Extraction Unit, Batch Reactor Assembly, Starch Hydrolyzing and Distillation Unit

Process Development /Petroleum testing Laboratory

Analytical equipment: viscosimeters, hydrometers, colorimeter, moisture balance, refractometer, pH meter, conductivity meter, flash and cloud point apparatus, fluid bed

dryer, autoclave, cutting mill, vacuum pump, weighing balance, bomb and colorimeter, Soxhlet extractor, automated pressure, automated pH control process, automated temperature.
Process rig, gas chromatograph, atomic absorption spectroscopy AAS, scanning electron microscope.

Reaction, catalysis, and petrochemical analysis laboratory

Gyratory shaker, stuart with accessory, laboratory oven, water bath, rotary evaporator, autoclave, centrifuge, liquid chemical reactor reaction vessel with pressure gauge, vacuum pump, batch reactors, reaction distillation unit, electric heating mantle and electromagnetic stirrer, burettes, pipette, beakers, laboratory chemicals.

Computer/Animation Laboratory

The computer laboratory should have at least 50 PCs and at least three petrochemical engineering software (ASPEN HYSYS packages, CHEMCAD, POYMATH, MATLAB) plus AutoCAD installed. Animation videos on several petrochemical plants such as the production of polymers. Fuel blending, pyrolysis of seeds to fuel oil. Ethylene glycol, ethylene acetate, production of sulphuric, phosphoric fertilizers. Production of gasoline, naphtha, kerosene, fuel, and lubricating oils, paraffin wax, asphalt etc.
Inclusion of LabView software on the PCs. (LABVIEW Stands for Laboratory Virtual Instrumentation Engineering Workbench). It is mostly used for automating the usage of processing and measuring equipment in all the laboratory setup. It is used in the field of industrial automation, instrument control, data acquisition and more).
Inclusion of SCILAB software (SCILAB is a numerical computation package that is very important in instrumentation and control engineering. It is also used in data analysis, signal processing, simulation of fluid dynamics and image enhancement).

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices

The following are the NUC requirements for various physical spaces:

Academic	**m^2**
Professor's office	18.50
Head of Department's office	18.50
Tutorial teaching staff space	13.50
Other teaching staff space	7.00
Technical staff space	7.00
Science staff research laboratory	16.50
Engineering staff research laboratory	14.50
Seminar space per student	1.85
Drawing office space (A.O. Board) (per student)	4.60
Drawing office space (A.I. Board) (per student)	3.70
Laboratory space	7.50
Non-academic	
Secretarial space	7.00

Office Facilities

S/No	Office	No in Room	Facilities
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Petroleum and Gas Engineering

Overview

The Petroleum and Gas (Oil and Gas) Engineering curriculum is designed to provide the student with the strong foundation in science and engineering needed by petroleum and other related industries engaged in exploitation of oil and natural gas resources from underground reservoirs. The curriculum blends the natural sciences (mathematics, physics, chemistry and geology), the engineering science (thermodynamics, mechanics, dynamics, hydraulics and strength of materials), and information technology skill to create a programme that is relevant in solving the diverse problems in the oil and gas industry.

The programme covers the fundamentals of petroleum engineering science and technology, including the flow of fluids, drilling and production operations separation processes, unit processes, inorganic and organic chemical equilibrium, and economics. The programme prepares students for engineering duties in the petroleum industry as well as related chemical process industry.

Philisophy

To achieve national goals and objectives of industrialisation and self-reliance in the energy sector, producing competent graduates in petroleum and gas (oil and gas) engineering with high academic standard and adequate practical background is needed to meet the manpower requirement and the short and long-term uncertainties associated with the energy industry.

The philosophy of the program is to train and produce competent graduates in petroleum and gas (oil and gas) engineering with high academic standard and adequate practical background needed to meet the manpower requirement and the short and long-term uncertainties associated with the energy industry and achieve national goals and objectives of industrialisation and self-reliance in the energy sector.

Objectives

The objectives of the programme in Petroleum and Gas (Oil and Gas) Engineering are to:

1. train professional candidates capable of applying engineering principles and practices for the safe and efficient exploration, development, production, transportation and management of petroleum resources;
2. train engineers who can design processes and machines, manufacture, utilise and maintain oilfield equipment for exploitation of the earth's petroleum resources in an environmentally safe and efficient manner;
3. train professionals who will be able to integrate key science and engineering principles to address the technological challenges of the petroleum and natural gas industry;
4. make graduates exercise original thought, have good professional judgment and be able to take responsibility for the direction of important tasks;
5. enable graduates to manage people, funds, materials and equipment; and
6. improve on indigenous technology to enhance local problems-solving capability.

Unique Features of the Programme

The unique features of the new Petroleum and Gas (Oil and Gas) Engineering programme are as follows:

1. There is emphasis on outcome-based education with clearly defined course content and learning objectives.
2. Workload is reduced to give room for independent learning and creativity.
3. The core engineering programme is enhanced with the introduction of courses like Artificial Intelligence, Machine Learning, Convergent Technologies, Data Analytic and Renewable Energy Resources which are important in a modern-day society.
4. The computer programming course is now streamlined to be on modern programming languages instead of the old FORTRAN.
5. Introduction of a course on entrepreneurship in the oil and gas industry will be an eye opener to the opportunities in the oil and gas industry. This complements the entrepreneurship course taught as a General Studies course.
6. The refined SIWES programme will ensure that relevant practical experience is acquired by the students before graduation.
7. There is more field exposure with the introduction of field trips in courses like Introduction to Oil and Gas Industry and Petroleum Geology.
8. The final-year project and Research Methods are lumped together and to be started in the first semester. This makes it possible to choose research topics and get to research methodology before the beginning of the second semester.
9. The robust course content of our communication course will help our engineers write better report and make good presentations.

Employability Skills

Graduates of this Petroleum and Gas (Oil and Gas) Engineering Program will have sufficient science, engineering and programming knowledge that they can easily adapt to working in any engineering outfit. Particularly, they should have good understanding of oil and gas business to be employed as:

1. Reservoir Engineers
2. Production Engineers
3. Drilling Engineers
4. Petroleum Economists
5. Oil and gas research Engineers

The graduates should also be able to work in the following oil and gas service companies:

1. Reservoir management
2. Mud logging
3. Electric and slickline companies
4. Pipeline companies
5. Oil and gas facility management
6. PVT laboratory

21st Century Skills

The modern skills emphasised in this programme are as follows:

1. Software development and application skill;
2. Learning to learn/metacognition;
3. Creativity and innovation;

4. Artificial intelligence and data analytic skill;
5. Critical thinking/problem-solving/decision making skill;
6. Entrepreneurship skill;
7. Communication skill; and
8. Collaboration (teamwork).

Admission and Graduation Requirements

Admission Requirement

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students

Global Course Structure

Year	GST/ENT	Basic Science	GET	PGE	SIWES	Total Units
100	4	18	3	2	-	27
200	4	-	23	-	3	30
300	4	-	15	10	4	33
400	-	-	-	-	8	08
500	-	-	5	5	-	10
	12	**18**	**46**	**29**	**(15)***	**105**

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Cultures	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Mechanics I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
PGE 101	Introduction to Petroleum and Gas Industry with Field Trip	2	C	15	45
	Total	**27**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-

GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students' Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**27**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Conver-gent Technologies	3	C	45	
PGE 301	Rock and Fluid Properties	3	C	45	-
PGE 302	Petroleum Engineering Lab 1	2	C	-	45
PGE 303	Drilling and Well Design I	3	C	45	-
PGE 304	Fundamentals of Reservoir Engineering	2	C	30	-
PGE 305	Oil and Gas Production Engineering I	2	E	30	-
PGE 306	Gas Instrumentation Laboratory	3	E	-	45
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**29**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
PGE 401	Entrepreneurship and Startup/Oil and Gas Business Project	2	E	30	-
PGE 403	Natural Gas Engineering	3	E	45	
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH	PH
GET 299	SIWES I: SIWEP	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III: SIWES	8	C	24 weeks	
	Total	**15***			

* All credited in 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
PGE 501	Natural Gas Handling, Processing and Safety	2	C	30	-
PGE 502	Transportation and Pipeline Technology	3	C	30	-
PGE 504	Natural Gas Utilisation and Monetisation Concepts	2	E	30	-
	Total	**10**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;

3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents
Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.
PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;

3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PGE 101: Introduction to Petroleum and Gas Industry (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the principles and operation of the three geophysical methods (magnetic, gravimetric and seismic) employed for oil and gas exploration activities;
2. describe the origin, formation, migration and entrapment of petroleum, oil and gas windows and conditions necessary for accumulation or entrapment.
3. describe oil and gas well drilling operations;
4. distinguish between oil and gas reservoirs by basic conditions, using the phase diagram;
5. appreciate oil and gas production, processing and transportation systems;
6. explain unconventional sources of natural gas and be aware of the well logs combination that could aid in the delineation of shale gas reservoirs.

Course Contents
Geophysical methods of petroleum exploration. Principles of petroleum geology. Drilling for oil and gas: Oil and gas reservoir; oil and gas production; oil and gas processing; oil and gas transportation. Unconventional Sources; shale gas, gas hydrates, coalbed methane, landfill and biogas technology.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking).

Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30, PH 45)

Course Learning Outcomes

Students will be able to:

5. discuss the fundamental concepts of electricity and electrical d.c. circuits;
6. state, explain and apply the basic d.c. circuit theorems;
7. explain the basic a.c. circuit theory and
8. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which

enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering).

Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;

11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-v-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;

4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;

4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python "AI" libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

PGE 301: Rock and Fluid Properties (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise reservoir forming rock types (sandstone and carbonate), their textures and pore structures;
2. handle and prepare cores according to standard core handling procedures;
3. define porosity, discuss the factors which affect porosity, and describe the methods of determining the values of porosity;
4. explain the thermodynamic behaviour and phase equilibria of reservoir rock and fluids;
5. describe methods of determining fluid saturations in reservoir rock and show relationship between fluid saturation and capillary pressure;
6. demonstrate the techniques of averaging porosity, permeability and reservoir pressure data;
7. appreciate the chemical and physical properties of the different reservoir fluids;
8. use reservoir phase behaviour to analyse reservoir fluid characteristics; and
9. explain fundamental concepts in the determination and evaluation of fluid properties.

Course Contents

Composition and porosity of reservoir rock. Darcy's law and the concept of permeability and relative permeability; capillary phenomena, surface tension forces, wettability, compressibility and static distribution of fluids. Electric conductivity; chemical, physical and thermodynamic properties of underground fluid. Gas laws. Behavior of liquid. Phase equilibrium. Viscosities of hydrocarbons. Uses of fluid properties in reservoir engineering. Rock and fluid property correlations.

Laboratory

The laboratory section is based on materials covered in this course, including coring and core analysis, determination of petrophysical properties such as porosity, permeability, water saturation, gas formation volume factor, etc. (I Unit).

PGE 302: Petroleum Engineering Laboratory 1 (3 Units C: PH 135)

Learning Outcomes

At the end of this course, the students should be able to:

1. analyze drill cuttings;
2. determine the lithology of a given formation;
3. determine rock properties (porosity, permeability, fluid saturations, capillary pressure curves and others) and fluid properties (bubble point pressure, dew point pressure and oil formation volume)

Course Contents

Analysis of drill cuttings. Determination of lithology. Determination of porosity. Fluid saturations. Capillary Pressure. Permeability; electrical properties, effective permeability and relative permeability. Physical properties of petroleum and its products. Gravity. Viscosity. Surface tension. Thermodynamic behavior of naturally-occurring hydrocarbon mixtures. Differential and flash vaporisation tests at elevated pressures and temperatures.

PGE 303: Drilling and Well Design I **(3 Units C: 45 LH)**

Learning Outcomes

At the end of this course, the students should be able to:

1. Understand Bit selection and evaluation the bits ability a drill Bit. Not clear
2. demonstrate an understanding of the fundamentals of oil well drilling, especially the techniques employed for oil well completion; and
3. plan a drilling operation to include cost estimation, assemblage of a drilling team, rigs and rig power systems, hoisting.

Course Contents

Introduction to drilling engineering. Fundamental concepts in oil well drilling. Well planning and cost estimation. Drilling team, drilling rigs, rig power system, hoisting system, circulation system, the rotary system, the well control system, well-monitoring system, special marine equipment, drilling cost analysis, and bit types available. Rock failure mechanisms. Bit selection and evaluation. Factors affecting tooth wear, bearings wear, and terminating a bit run. Factors affecting penetration rate, bit operation, drilling fluids and drilling hydraulics, and well head equipment.

PGE 304: Fundamentals of Reservoir Engineering **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. characterise a petroleum reservoir;
2. perform an in-situ-evaluation of the hydrocarbon stock in the oil and gas before gathering;
3. carry out various calculations to ascertain recoverable hydrocarbons;
4. perform material balance calculations required in water influx-models;
5. apply fluid flow concepts to recover hydrocarbons from oil and gas wells; and
6. use decline curve analysis to estimate recoverable hydrocarbons.

Course Contents

Introduction: Functions of a reservoir engineer; characteristics of petroleum reservoir; geological concepts in reservoir engineering; recovery methods and definitions of reservoirs. Determination of hydrocarbon in-place for oil and gas recovery: volumetric methods; material balance and applications; water influx models and calculations; uncertainties in reserve calculations. Fluid flow concepts; flow potential; Darcy's Law. Decline curve analysis.

PGE 305: Oil and Gas Production Engineering I **(2 Unit E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. explain subsurface and surface operation in petroleum and gas engineering;
2. use nodal analysis to analyse inflow and outflow performance;
3. explain the workings of the equations IPR;
4. calculate productivity index and skin effects;
5. appreciate how well head equipment performs in production;
6. be introduced to flow assurance problems and how to proffer solutions; and
7. discuss the application of artificial lift methods in the production of oil and gas.

Course Contents

Introduction to petroleum engineering: Subsurface and surface operations. Operational functions and output of subsurface production engineer. Nodal analysis in flow and outflow performances: governing equations, inflow performance relationship (IPR), productivity index, formation damage, fines migration and skin effect, vertical lift well head equipment performance and pressure losses, and choke performance. Problem wells analysis: sand, water, hydrate, scale, unstable flow, surge, waxy crude production, etc. Well surveillance. Well stimulation: fracturing and acidising. Introduction to artificial lift methods. Gas lift and pumping system.

PGE 306: Gas Instrumentation Laboratory (3 Units E: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. explain the basic principles of measuring pressure, temperature and volume;
2. describe how flow parameters are controlled; and
3. apply and analyse results obtained from the following laboratory equipment: thermometer, pressure gauge, thermocouple, flow meter, manometer, gas chromatography and mass spectrometer.

Course Contents

Applications for thermometers, pressure gauges, thermocouples, flow meters, and manometers in gas systems. Construction and operation of simple pipelines using steel and plastic pipes. Determination of rate of heat flow and thermal efficiency of burners and furnaces and boilers. Chemical composition and flue gas analysis. Gas chromatograhpy, mass spectrometer and sampling system.

400 Level

GET 499: Students Industrial Work Experience III (8 Units: C, 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

PGE 401: Oil and Gas Entrepreneurship Project (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the basics of entrepreneurship and how to start one's business;
2. describe the opportunities in the oil and gas industry;
3. leverage on the Nigerian Content Act;
4. develop a team project to exploit opportunities in the oil and gas industry; and
5. analyse the challenges in the oil and gas from case histories.

Course Contents

Understanding the Nigerian and global business environment. Doing business in Africa, engineering and AfCFTA. Overview of Entrepreneurship: origins, definitions, entrepreneurship and technopreneurship. Steps for successful entrepreneurship start-up; Nigerian content opportunities; business registrations. Sources of funding. Gains and pains of business growth. Joint ventures and special purpose vehicles in PPPs. Business development – business information, promotion, marketing tools and strategies, basic personnel management, client recruitment and management. Business proposals and plans. Profiles of business ventures in the oil and gas industry. Business/enterprise commercialisation and digitisation, FINTECHs, TECH hubs, etc. Financial management and business sustainability. Entrepreneurship team projects (well testing, reservoir management, mud-logging, core analysis, PVT analysis, environmental laboratory, pipeline.). Guest presentations.

PGE 403: Natural Gas Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between different types of natural gas and calculate physical properties of natural gas and associated gas;
2. differentiate between all types of gas reservoirs and identify the characteristics and conditions for each type as well as calculate gas reserve in each type;
3. design gas well testing and analyse recorded data of pressure-flow rate for interpreting initial reservoir pressure and expected skin factor as well as reservoir permeability;
4. analyse different types of gas reservoir deliverability tests and predict current and future reservoir performance;
5. analyse decline rate data for predicting future gas reservoir deliverability using different techniques of decline rate analysis (DCA);
6. identify different types of gas flow meters and apply mathematical models to calculate gas flow rates;
7. design pipeline networks and gathering stations and apply mathematical models for the optimum operating conditions at surface facilities;
8. handle the sour gas problem by suggesting various gas treating methods; and
9. describe the design of gas storage facility.

Course Contents

Properties of natural gases, hydrate formation. Estimation of gas and gas condensate reserves. Gas well testing. Estimation of gas reserves (conventional and unconventional).

Gas flow measurement. Natural gas deliverability. Natural gas transmission. Design of gathering systems. Field handling of natural gas. Sour gas problems. Gas condensate fields and storage of gas. Compressor horsepower requirement.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/ancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

PGE 501: Natural Gas Handling, Processing and Safety (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain some of the basic thermodynamic concepts used in gas processing;
2. discuss the concept of fractional distillation and other distillation processing;
3. describe the mechanism and technology of absorption and adsorption in the processing of natural gas (industrial processes); and
4. discuss the concepts of gas purification and odourisation.

Course Contents
Application of the concepts of thermodynamics and phase behavior in the processing and conditioning of natural and liquids. Absorption, adsorption and fractionation processing; gasoline plant design; liquefied petroleum gas (LPG); liquefied natural gas (LNG). Other sources of gas.

PGE 502: Transportation and Pipeline Technology (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the importance of transportation in the petroleum industry;
2. explain the concepts governing rheological models;
3. apply most common pipeline design equation for simple design problems;
4. use pipeline design specifications and standards appropriately;
5. analyse the impact of corrosion and corrosion-related problems in pipeline utilisation; and
6. size and select pipeline associated equipment such as compressors, pumps and valves.

Course Contents
Transportation in the petroleum industry. Pipeline design specification and standards. Rheology, concepts and models. Pipeline design models. Conventional models and energy cost optimization models. Gas pipeline handing facilities, compressors/pumps, sizing, selection and operations. Corrosion control. Pipeline surveillance. Virtual pipeline technologies.

PGE 504: Natural Gas Utilisation and Monetisation Concepts (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. use gas technology in acoustic and combustion engineering;
2. design furnace and burners for gas combustion;

3. describe the various processes involved in the conversion or use of gas either as a fuel or as an ingredient (raw material) in the following industries:
    a. Petrochemical, cement, paper and pulp
    b. Fertilizer, power plants andair-conditioning
    c. Medical equipment/anesthetics
    d. Processes of gas utilisation in the industries above;
4. Calculate waste heat and develop waste heat recovery programs in plants;
5. explain domestic gas utilisation in the areas of cooking/heating/drying; and
6. discuss the effects and significance of gas prices on gas utilisation/monetisation.

Course Contents

Review of thermodynamic concepts. One dimensional gas dynamics. Continuity equation, energy and euler's equations and reservoir conditions. The momentum equation, isentropic condition andBernoulli equation. Dynamic pressure and flow at constant area. Supersonic flow in ducts. Frictionless flow effects of viscosity and conductivity. Fundamental technologies and engineering aspects of industrial gas utilisation. Relevant aspects of fluid dynamics, heat transfer, combustion, and acoustics. Technology of industrial gas utilisation, including refractory materials, burner and furnace design, safety, measurement and control. Gas utilisation in the following industries: glass, aluminium, steel, fertilizer, petrochemicals, cement, paper and pulp, power plants, drying and air conditioning. Temperature control of furnaces; waste heat recovery; efficiency of furnaces. Domestic gas utilisation. Effects of gas prices, characteristics and quality. Emphasis will be laid on safety and control.

PGE 510: Research Methods and Project (6 Units C: LH 15; PH 90)

Learning Outcomes

At the end of this course, the students should be able to:

1. undertake and complete successfully an independent or team project;
2. source for information for engineering work; and
3. communicate engineering information.

Course Contents

The students will be taught methods on how to carry out research. The research method must be a first semester course and the evaluation of the course will primarily depend on the ability of the student to develop a good proposal on the topic he or she was assigned or chosen. **(1 Credit)**

An individual or team project selected from a list of projects at the beginning of the final year. Work on the project continues throughout the final year under the supervision of a lecturer. Students may also suggest their own projects. The project report must be typed, bound and defended before the Departmental Academic Board and an external examiner before graduation. **(5 Credits)**

Minimum Academic Standards

Equipment

Drilling Fluid and Cement Laboratory

Mixers and cups
Marsh funnels
Direct indication viscometers
Consistometer

Pressure filter press
Constant temperature water bath
Roller oven
Standard API sand sieve
Retort kit
Resistivity meter
Mud rheometers
pH meters
Mud balance
Chemical balance
Standard filter press
Filter papers
Bentonite, barytes and mud additives (chemicals)
Cement analyser

List oF PVT Laboratory Equipment

Visual PVT cell
Recombination cell
Oil molecular weight tester (Cryette Cryoscope)
Multi-stage flash separator
Gasometer
Digital density meter
High pressure high temperature density meter (Pycnometer)
Electromagnet viscometer or rolling ball viscometer
Gas cylinder
Oil cylinder
Gas chromatograph (with all support gases such as hydrogen, air and helium) for gas analysis
Gas chromatograph (with all support gases such as hydrogen, air and helium) for liquid analysis
Positive displacement pump
PVT surface sampling kits
Pressure generator system
Sample restoration apparatus
Weigh balance

Other Accessories in the PVT Laboratory

Heating mantle
UPS
Digital pressure gauge
Piping materials for gas chromatograph installation

Core Analysis and Reservoir Engineering Laboratory

S/N	Equipment	Accessories
1	Resistivity meters tensiometer	
2	Core slabbing crosscut and band saws	
3	Core milling machine	
4	Core preservation system	Refrigerator, wax bath and core trays

5	Dean stark equipment	
6	Distillation assembly	Compressor
7	Porosimeters	Nitrogen cylinder/gas
8	Core cleaner (Soxhlet extractor)	Heating mantle and oven
9	Centrifugal extractor	
10	High pressure saturator	
11	Capillary pressure test equipment	
12	Refractometer	
13	Liquid and gas permeameters	Nitrogen cylinder/gas
14	Planimeter	
	Other Equipment	
15	Core trimming/cutting machine	
16	CT scanner	
17	Gamma ray logging machine	
18	Digital core photography camera	
19	Humidity and conventional oven	
20	Particle size analyzer	
21	Retort oven	
22	Miniature core flooding system	Compressor nitrogen cylinder/gas
23	Amott cell	

Production Laboratory
Viscosimeters
Hydrometers
Corrosion test kits
Flow meter rig
Centrifuge

Computer Laboratory

The computer laboratory should have at least 40 PCs, with at least one of the following softwares installed.

No.	Area	Software	Purpose
1	Reservoir engineering	MBAL	Material balance calculation/Decline curve analysis
2	Reservoir engineering	ECLIPSE	Dynamic simulation
3	Production	PROSPER	Nodal analysis, stimulation, gaslift design
4	Formation evaluation	TECHLOG	Petrophysical evaluation
5	Geology	PETREL	Seismic and 3-D modeling
6	Economics	CYRISTAL BALL	Economic evaluation
7	Field development	QUESTOR	Cost estimation and development/ Concept selection

Other Requirements for Training of Students

CD/DVD players
LCD screens
Projectors
Wireless speakers
Audio CDs, tapes, etc. On petroleum engineering courses
Some disused oil field equipment like stabilizers, centralisers, drilling bits, well head assembly, gas lift mandrels, etc.
Demonstration rigs
Demonstration flow stations

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and

3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library
There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, and standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices
The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's office	18.50
Head of Department's office	18.50
Tutorial teaching staff space	13.50
Other teaching staff space	7.00
Technical staff space	7.00
Science staff research laboratory	16.50
Engineering staff research laboratory	14.50
Seminar space per student	1.85
Drawing office space (A.O. board) (Per student)	4.60
Drawing Office Space (A.I. board) (Per student)	3.70
Laboratory space	7.50
Non-Academic	
Secretarial space	7.00

Office Accommodation
The requirements for office accommodation are:

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Petroleum Engineering

Overview

The Petroleum Engineering curriculum is designed to provide students with the strong foundation in science and engineering needed by petroleum and other related industries engaged in exploitation of oil and natural gas resources from underground reservoirs. The curriculum blends the natural sciences (mathematics, physics, chemistry and geology), the engineering science (thermodynamics, mechanics, dynamics, hydraulics and strength of materials), and information technology skills to create a programme that is relevant in solving the diverse problems in the oil and gas industry.

The programme covers the fundamentals of petroleum engineering science and technology, including the flow of fluids, drilling and production operations separation processes, unit processes, inorganic and organic chemical equilibrium and economics. The programme prepares students for engineering duties in the petroleum industry as well as related chemical process industries. The main focus is on the identification, extraction, storage and transportation of crude oil and natural gas. The primary specialisation is on oil well drilling, reservoir engineering and oil and gas production engineering. The main subjects covered are as follows:

1. classification of Reservoirs and concepts of Fluid Flow Concepts and Recovery Processes;
2. estimation of Crude Oil and Natural Gas Reserves;
3. well Drilling Equipment and Facilities required for Operations on Land, Swamp and Offshore;
4. surface and Sub-surface Production Equipment and Operations; and
5. storage and Transportation Equipment/Facilities and Operations.

Philosophy

To produce petroleum engineering graduates with high academic and ethical standards and adequate practical exposure for self-actualisation as well as being of immediate value to the oil and gas industry and the community in general.

Objectives

The goal and objectives of Petroleum Engineering education and training should be in consonance with the realisation of national needs and aspirations in relation to industrial development and technological emancipation from foreign companies in our oil and gas industry. The graduates of Petroleum Engineering programme must therefore be knowledgeable, creative, resourceful and able to perform the following functions:

1. conduct investigations into complex petroleum engineering problems and produce viable solutions that optimise the use of our local resources;
2. outline the dynamics of both the local and global oil and gas industry;
3. adapt and adopt exogenous technology in order to solve peculiar engineering problems in the Nigerian oil and gas industry;
4. design petroleum engineering projects and supervise their implementation;
5. exercise original thought, good professional judgment and responsibility for the execution of oil and gas projects in a manner that guarantees sustainable development;
6. show familiarity with all the materials, codes, components, machines, equipment, production techniques and systems in the oil and gas industry;
7. manage people, fund, materials and equipment;
8. have good knowledge of the ethics of the engineering profession and application;

9. work alone or in a team, especially a multidisciplinary team, and also have good oral and written communication skills; and
10. develop lifelong learning ability for continuous self-improvement.

Unique Features of the Programme

The unique features of the new Petroleum Engineering programme are as follows:

1. there is emphasis on outcome-based education with clearly defined course content and learning objectives;
2. workload is reduced to give room for independent learning and creativity;
3. the core engineering programme is enhanced with the introduction of courses like Artificial Intelligence, Machine Learning, Convergent Technologies, Data Analytics and Renewable Energy Resources which are important in a modern-day society;
4. the computer programming course is now streamlined to be on modern programming languages instead of the old FORTRAN;
5. introduction of a course on entrepreneurship in the oil and gas industry will be an eye opener to the opportunities in the oil and gas industry. This complements the entrepreneurship course taught as a General Studies course;
6. introduction of computer applications in many courses will help the students in this era of software applications;
7. the refined SIWES programme will ensure that relevant practical experience is acquired by the students before graduation;
8. there is more field exposure with the introduction of field trips in courses such as Introduction to Oil and Gas Industry and Petroleum Geology;
9. we expect better appreciation of Nigerian fields with the introduction of case histories. This will also bring the students closer to the industry;
10. the final-year project and Research Methods are lumped together and to be started in the first semester. This makes it possible to choose research topics and get to research methodology before the beginning of the second semester; and
11. the robust course content of our communication course will help our engineers write better reports and make good presentations.

Employability Skills

Graduates of this Petroleum Engineering programme will have sufficient science, engineering and programming knowledge that they can easily adapt to working in any engineering outfit. Particularly, they should have good knowledge of oil and gas business that enables them to be employed as

1. Reservoir Engineers
2. Production Engineers
3. Drilling Engineers
4. Oil and Gas Economists.
5. Oil and Gas Research Engineers

The graduates should also be able to work in the following oil and gas service companies:

1. reservoir management
2. mud logging
3. electric and slickline companies
4. pipeline companies
5. oil and gas facility management
6. PVT laboratory

21^{st} Century Skills

The modern skills emphasised in this programme are as follows:

1. software development and application skill;
2. creativity and innovation;
3. learning to learn/metacognition;
4. information literacy;
5. artificial intelligence and data analytic skill;
6. critical thinking/problem-solving /decision making;l
7. entrepreneurship skill;
8. communication skill; and
9. collaboraytion (teamwork and ethic).

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Year	**GST**	**ENT**	**Sciences**	**GET**	**PEE**	**SIWES Courses**	**Total**
1	4	-	18	3	2	-	27
2	2	2	-	26	0	3	33
3	2	2	-	10	8	4	26
4		-	-	-	0	8	08
5		-	-	5	6	-	11
Total	**8**	**4**	**18**	**44**	**31**	**15***	**105**

* All SIWES courses credited at the end of 2nd Semester of 400 Levl

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	30
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
PEE 101	Introductory to Petroleum and Gas Industry	2	C	15	45
	Total	**27**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	=
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
GET 301	Engineering Mathematics III	3	C	45	-
PEE 201	Petroleum Geology	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**33**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 304	Engineering Communication, Technical Writing and Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	
PEE 304	Drilling Technology I	2	C	30	-
PEE 305	Drilling Fluid Technology Laboratory	1	C	-	45
PEE 306	Rock and Fluid Properties	2	C	30	-
PEE 307	Rock and Fluid Properties Laboratory	1	C	-	45
PEE 309	Petroleum Production 1	2	E	30	-
PEE 310	Fundamentals of Reservoir Engineering	2	E	30	-
PEE 312	Production and Reservoir Laboratory	2	E	-	90

PEE 313	Applied Geophysics and Petroleum Exploration	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**22**			

400 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
PEE 401	Entrepreneurship and Startup/Oil and Gas Business Project	2	E	30	-
PEE 405	Introduction to Well Logging and Interpretation	2	E	30	-
GET 399	SIWES I: Students Work Experience Scheme	8	C	10 Weeks	
	Total	**0**			

***SIWES Courses**

Course Code	**Course Title**	**Units**	**Status**	**PH**
GET 299	SIWES I: SIWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

*All credited in second semester of 400 level

500 Levels

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
PEE 508	Research Methods and Project (Experiential)	6	C	15	225
	Total	**11**			

Course Contents and Learning Outcomes

100 Level Courses

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;

6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology); English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations); major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights;
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3d objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids

and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) **(2 Units C: LH 30)**

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) **(2 Units C: LH 30)**

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PEE 101: Introduction to Petroleum and Gas Industry (2 Units C: LH 15;PH 45)

Learning Outcomes

At the end of the course, student should be able to:

1. understand of the principles of operation of the three geophysical methods (magnetic, gravimetric and seismic) employed for oil and gas exploration activities;
2. understand the origin, formation, migration and entrapment of petroleum; oil and gas windows and conditions necessary for accumulation or entrapment;
3. understand the basic knowledge of oil and gas well drilling operations;

4. distinguish between oil and gas reservoirs by basic conditions, using the phase diagram; be aware of the well logs combination that could aid the delineation of shale gas reservoirs;
5. have an appreciation of the oil and gas production, processing and transportation systems;
6. have some understanding of unconventional sources of natural gas; and
7. be acquainted with Society of Petroleum Engineers.

Course contents
Historical background, sources, world supply and demand; Geophysical methods of petroleum exploration; Principles of petroleum geology; Drilling for oil and gas: Oil and gas reservoir; Oil and gas production methods; Oil and gas processing; Oil and gas transportation; Unconventional Sources: Shale Gas, Gas hydrates, Coalbed Methane, Landfill and Biogas technology. Career Development Resources including information on Society of Petroleum Engineers and other professional groups.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;

4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 units C: LH 30; PH 45)

Learning Outcomes
Students will be able to:
1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents
Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, and susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to :
1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;

3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;

4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;

3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and

6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;

5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

PEE 201: Petroleum Geology with Field Trip (3 Units; C: LH 30; PH 45)

Learning Outcomes

At the end of the course, students should understand the following:

1. the fundamentals of Geology that need to be understood and integrated with engineering data to effectively and optimally manage petroleum reservoirs;
2. conditions necessary for Petroleum formation and accumulation;
3. the various methods of evaluating source rock potential;
4. the differences and peculiarities of some Nigerian basins;
5. the variety of geologic data that are integrated together to carefully describe the three-dimensional geometry of a reservoir; and

6. be able to prepare various subsurface maps and calculate reserves;

Course Contents

Earth Structure and Depositional Systems. Origin, Maturation, Migration and Accumulation of Petroleum. Trapping Mechanisms. Abnormal pressure. Petroleum prospecting and tools. Uses of geological data, reservoir rocks and fluids. Subsurface maps, Correlation principles. Petroleum as a resource. Petroleum Geology of Nigerian Sedimentary Basins and Evaluation: Niger Delta, Chad Basin, Anambra Basin, etc.

NOTE: Geologic field trip added for completeness

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation.

Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);

2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in solidworks; and
d. technical report writing.

PEE 304: Drilling Technology I (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:
1. demonstrate understanding of the fundamentals of oil well drilling especially the techniques employed for oil well completion;
2. understand Bit selection and evaluation and bit's ability to drill through reservoir rock by considering bit tooth wear on bit bearings and how to terminate the bit run; and
3. be able to plan a drilling operation to include cost estimation, assemblage of a Drilling team, rigs and rig power systems and hoisting.

Course contents

Introduction to Drilling Engineering. Fundamental concepts in oil well drilling. Well planning and cost estimation. Drilling team, drilling rigs, rig power system, hoisting system, circulation system, the rotary system, the well control system, well-monitoring system, special marine equipment, drilling cost analysis, Bit types. Rock failure mechanisms. Bit selection and evaluation. Factors affecting tooth wear, bearings wear, terminating a bit run. Drilling Performance: Factors affecting penetration rate, bit operation, drilling fluids and drilling hydraulics. Well Head equipment.

PEE 305: Drilling Fluid Laboratory (1 Unit C: PH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. appreciate the functions of drilling fluids and how their rheological properties are affected by physical and chemical additives;
2. understand laboratory measurement of drilling fluid properties; and
3. understand why we have damaging and non-damaging drilling fluids.

Course Contents

Functions and composition of drilling fluids. Laboratory determination of rheological properties of drilling fluids. Damaging and Non-Damaging drilling and Completion Fluids. Drill cutting evaluation. Drilling mud calculation, control of mud properties. Drilling mud performance evaluation. Well completion fluid.

PEE 306: Rock and Fluid Properties (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should:
1. comprehend the properties of reservoir rock: porosity, permeability, conductivity;
2. understand the reservoir fluid properties and how they vary with pressure and temperature;
3. know the thermodynamic behaviour and phase equilibria of reservoir fluids;

4. understand the rock-fluid interaction and how they influence fluid distribution in the reservoir;
5. undertake basic calculations using Darcy's Law, capillary pressure data, Leverett J-Function, etc;
6. have knowledge of the effect of surface tension and wettability on the phenomenon of capillarity; and
7. understand PVT Experiments.

Course Contents
Composition and porosity of reservoir rock. Darcy's Law and the concept of permeability and relative permeability. capillary phenomena, surface tension forces, wettability, compressibility and static distribution of fluids. Electric conductivity. chemical, physical and thermodynamic properties of underground fluid. Gas laws. Behavior of liquid. Phase equilibrium. Viscosities of hydrocarbons. Uses of fluid properties in Reservoir Engineering. Rock and Fluid Property correlations. Description of PVT Experiments.

PEE 307: Rock and Fluid Properties Laboratory (1 Unit C: PH 45)

Learning Outcomes

This is the laboratory component of PEE 306. It therefore enhances understanding of PEE 306.

Course Contents
Laboratory section are based on materials covered in PEE 306 which includes coring and core analysis, determination of petrophysical properties, such as porosity, permeability, water saturation, Gas Formation Volume Factor etc.

PEE 309: Petroleum Production Engineering I (2 Units E: LH 30)

Learning Outcomes
By the end of this course, the students should be able to:
1. explain the operations and equipment required for subsurface completion;
2. discuss pressure losses in subsurface completion equipment;
3. explicate inflow-outflow relationship and implications in the life of the well;
4. elucidate the basic concepts in artificial lifting (gaslift, pumping, *et cetera*) of oil;
5. discuss formation damage: sources, implications and remedies; and
6. determine the use of Nodal Analysis software.

Course Contents
Introduction to Petroleum Production Engineering: subsurface operations. Operational functions and output of subsurface production engineer. Well completion: tubing, types, tubing equipment, uses of tubing, calculations. use of wirelines. packers-types; uses. Multiple zone completion. Well heads - casing and tubing hangers. Christmas tree. Nodal analysis in flow and outflow performances: governing equations, inflow performance relationship (IPR), productivity index, formation damage, fines migration and skin effect, vertical lift well head equipment performance and pressure losses, choke performance. Problem wells analysis: sand, water, hydrate, scale, unstable flow, surge, waxy crude production, etc. Well surveillance. Well stimulation: Fracturing and acidizing. Introduction to artificial lift methods. Gas lift and pumping system. Computer Application for Nodal Analysis (Proper or alternative).

PEE 310: Fundamentals of Reservoir Engineering (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the characterisation of a petroleum reservoir based on PVT, drives;
2. perform an in-situ-evaluation of oil and gas reserve;
3. recommend ways of recovering hydrocarbons;
4. perform the material balance calculation and determine water influx;
5. apply fluid potential concept to determine flow in non-horizontal systems;
6. do Decline Curve Analysis;
7. apply Darcy's law; and
8. determine the use of Material Balance Software.

Course Contents

Introduction: Functions of a reservoir engineer. Characteristics of petroleum reservoir. Geological concepts in Reservoir Engineering. Recovery methods and definitions of reservoirs. Determination of hydrocarbon in-Place for oil and gas recovery: volumetric methods; material balance and applications. Water influx models and calculations. Uncertainties in reserve calculations. Fluid flow concepts. Flow potential. Darcy's Law. Decline Curve Analysis. Computer application (MBAL or alternative).

PEE 312: Production and Reservoir Laboratory (2 Units E: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. apply theories described in Reservoir and Production Engineering; and
2. explain the fabrication of the needed equipment

Course Contents

This course is basically to expose the students to some of the topics learnt in Fundamental of Reservoir Engineering, Production Engineering 1: Darcy's Law, Emulsion Treatment, Sand Consolidation. It is expected that all the main equipment in use would be fabricated.

PEE 313: Applied Geophysics and Petroleum Exploration (2 Units E: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. aply the fundamental principles of geophysics applied to oil and gas industry;
2. explain elastic theory and wave propagation in different formations; and
3. explain the synergy between the petroleum engineer, geologist and geophysicist in petroleum exploration.

Course Contents

The scope of geophysics. Solid earth geophysics. The shape of the earth. Geomagnetism. Marine geophysics; Isostacy. Geophysical instruments. Field data processing: electrical, seismic, radiometric, etc. Elastic theory. Waves and Ray path. Wave propagation. Seismic refraction principles and techniques including data acquisition. Seismic reflection principles and techniques - 2D, 3D, 4D (Time Lapse). Geophysical logging of borehole. Geophysical prospecting and exploration.

PEE 314: Petroleum Production Engineering II (Surface Production Operations) (1 Units C: LH 15)

Learning Outcomes

At the end of the course, students should be able to:

1. apply the concept of fluid separation using different types of separators;
2. explain the problems with fluid separation: emulsion, foaming, dehydration and treatment processes; and
3. undertake Separator and Compressor Design and explain the thermodynamics of compressors and compressor efficiencies.

Course Contents

Surface Equipment: Gathering systems, Design and Testing of flow lines, service and cleaning of systems. Phase separation: Separation process, separators and components design and construction of separators, dehydration, emulsion problems and treatment. Dew-point depression. Absorption and adsorption.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

NOTE: GET 399 as earlier described under Common GET Courses:

Additional Content for Petroleum Engineering, Petroleum and Gas (Oil and Gas) Engineering and Gas Engineering students:

Study of oil and gas industry, learning of software of oil and gas industry for applications in Petroleum Engineering, Gas Engineering, oil, and gas Engineering. Software such as PIPESIM, OLGA, PETREL, PROPER, ECLIPSE, ASPEN HYSYS PACKAGES, QUESTO, Oil field Manager. Use of animation videos for oil and gas industry.

400 Level

GET 499: Students Industrial Work Experience III (8 Unit C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at

400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

PEE 401 Oil and Gas Entrepreneurship and Start-up/Oil and Gas Business Project (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss the basics of entrepreneurship and how to start one's business;
2. discover opportunities in the oil and gas industry and also leverage the provisions of the Nigerian Content Act;
3. develop a team project to exploit opportunities in the oil and gas industry to encourage the students to nurse dreams early; and
4. identify the challenges in the oil and gas sector from case histories.

Course Contents

Understanding the Nigerian and global business environment. Doing business in Africa. Engineering and AfCFTA. Overview of entrepreneurship: origins, definitions, entrepreneurship and technopreneurship. Steps for successful entrepreneurship start-up. Nigerian content opportunities. Business registrations. Sources of funding. Gains and pains of business growth. Joint ventures and special purpose vehicles in PPPs. Business development – business information, promotion, marketing tools and strategies, basic personnel management, client recruitment and management. Business proposals and plans, Profiles of business ventures in the oil and gas industry. Business/enterprise commercialization and digitization, FINTECHs, TECH Hubs, etc. Financial management, Business sustainability. Entrepreneurship team projects (well testing, reservoir management, mud-Logging, core analysis, PVT analysis, environmental laboratory, Pipeline, etc). Guest presentations.

PEE 405: Well Logging and Interpretation (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the principles of open and cased hole logging tools;
2. read linear and logarithmic log curves;
3. identify the lithological sequence penetrated in the well;
4. calculate parameters needed for formation evaluation;
5. calculate movable and residual hydrocarbons in the well;
6. develop a computer processed well log;
7. Explicate the use of TECHLOG or PETREL in log analysis; and
8. evaluate recent advances in logging and log analysis

Course Contents
Principles and operation of gamma ray. Self-potential caliper. Resistivity (micro and focused), density neutron, sonic, cement bond and variable density, dip-meter and production well logging tools. Interpretation of well log and their cross-plotting techniques. Determination of formation properties such as porosity, hydrocarbon saturation, lithology, zone thickness, shaliness, etc. Guidelines for selecting proper logs in given field conditions. Computer aided analysis (PETREL); Recent advances in logging and log analysis.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possessthe skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;

3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principlesundertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/ancellation of ontract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

PEE 508: Research Methods and Research Project (6 Units C: LH 15; PH 225)

Learning Outcomes

At the end of this course, the students should be able to:
1. undertake and successfully complete an independent or team project;
2. source for information for engineering work; and
3. communicate engineering information diligently and with expertise

Course Contents

The students will be taught methods of carrying out research. The research methods must be a first semester course and the evaluation of the course will primarily depend on the ability of the student to develop a good proposal on the topic he/she chose or was assigned. **(1 Credit)**

An individual or team project selected from a list of projects at the beginning of the final year. Work on the project continues throughout the final year under the supervision of a lecturer. The student may also suggest their own project. The project report must be typed, bound and defended before the departmental academic board and an external examiner before graduation. **(5 Credit).**

Minimum Academic Standards

Equipment
List of Laboratory Equipment and Software

Drilling Fluid and Cement Laboratory

1. mixers and cups
2. marsh funnels
3. direct indication viscometers
4. consistometer
5. pressure filter press
6. constant temperature water bath
7. roller oven
8. standard API sand sieve

9. retort kit
10. resistivity meter
11. mud rheometers
12. pH meters
13. mud balance
14. chemical balance
15. standard filter press
16. filter papers
17. bentonite, barytes and mud additives(chemicals)
18. cement analyzer

List of PVT Laboratory Equipment

1. visual PVT cell
2. recombination cell
3. oil molecular eight tester (Cryette Cryoscope)
4. multi-stage flash separator
5. gasometer
6. digital density meter
7. high pressure high temperature density meter (pycnometer)
8. electromagnet viscometer or rolling ball viscometer
9. gas cylinder
10. oil cylinder
11. gas chromatograph (with all support gases such as hydrogen, air, and helium) for gas analysis
12. gas chromatograph (with all support gases such as hydrogen, air, and helium) for liquid analysis
13. positive displacement pump
14. PVT surface sampling kits
15. pressure generator system
16. sample restoration apparatus
17. weigh balance

Other Accessories in the PVT Laboratory

1. heating mantle
2. UPS
3. digital pressure gauge
4. piping materials for gas chromatograph installation

Core Analysis and Reservoir Engineering Laboratory

S/n	Equipment	Accessories
1	resistivity meters tensiometer	
2	core slabbing crosscut and band saws	
3	core milling machine	
4	core preservation system	refrigerator, wax bath, core trays
5	dean stark equipment	
6	distillation assembly	Compressor
7	Porosimeters	nitrogen cylinder/gas
8	core cleaner (soxhlet extractor)	heating mantle, oven

9	centrifugal extractor	
10	high pressure saturator	
11	capillary pressure test equipment	
12	Refractometer	
13	liquid and gas permeameters	nitrogen cylinder/gas
14	Planimeter	
	Other equipment	
15	core trimming/cutting machine	
16	CT scanner	
17	gamma ray logging machine	
18	digital core photography camera	
19	humidity and conventional oven	
20	particle size analyzer	
21	retort oven	
22	miniature core flooding system	compressor nitrogen cylinder/gas
23	amott cell	

Production Laboratory

a. Viscosimeters
b. Hydrometers
c. Corrosion test k
d. Flow meter rig
e. Centrifuge

Computer Laboratory

The computer laboratory should have at least 40 PCs with at least one of the following software installed:

No	Area	Software	Purpose
1	Reservoir Engineering	MBAL	material balance calculation / decline curve analysis
2	Reservoir Engineering	ECLIPSE	dynamic simulation
3	Production	PROSPER	nodal analysis, stimulation, gaslift design
4	Formation Evaluation	TECHLOG	petrophysical evaluation
5	Geology	PETREL	seismic and 3-D modeling
6	Economics	CYRISTAL BALL	economic evaluation
7	Field Development	QUESTOR	cost estimation and development concept selection

Other requirements for training of students
1. CD/DVD players
2. LCD screens
3. projectors
4. wireless speakers
5. audio CDs, tapes on Petroleum Engineering courses
6. some disused oil field equipment like stabilizers, centralizers, drilling bits, Well head

assembly, gas lift mandrels
7. demonstration rigs
8. demonstration flow stations

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC:

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate caliber for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level

Library

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirements:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Accommodation

S/N	**Office**	**No in Room**	**Facilities**
1.	HOD	1	table, chairs, A/C, filing cabinet, bookshelves, computer unit, secretary and facilities.
2.	Professor	1	table, chairs, A/C, filing cabinet, bookshelves, computer unit, secretary and facilities.
3.	Reader	1	table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	table, chairs, fan, filing cabinet, bookshelves

B.Eng. Structural Engineering

Overview
Structural Engineering focuses on analysing and designing structures with the aim of making sure they withstand the external forces that they experience including gravity loads, earthquake, wind, snow, and hydrodynamic forces. Structural engineers design buildings, bridges, dams, offshore oil platforms, jetties, industrial structures, power plants, and communication towers, among others.

Philosophy
The philosophy and mission statement of the Structural Engineering programme are to achieve the goals and objectives of the National Policy on Industrialisation, Self-Reliance and Economic Transformation. The overriding Philosophy is "to train structural engineering graduates that can operate at the highest level in solving the problems of our society in particular and contribute to the technical development of the world." In other word, "to produce graduates with high academic and ethical standards and adequate practical exposure for self-actualisation as well as being of immediate value to industry and the community in general".
Essentially, the Mission of the programme is to provide:

1. broad–based foundation and practical exposure in Engineering and Technology applications as well as specialised knowledge and practice in Structural Engineering;
2. adequate training in human behaviour, organisational management, entrepreneurial proclivity, sense of public responsibility and spirit of self-reliance;
3. basis for nurturing of partnerships between the academia and industry for effective programme delivery;
4. an awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
5. an awareness and understanding of the need to develop leadership and team building skills to maximize the benefits of Structural Engineering and its application in solving societal problems.

Objectives
The general goal and objectives of Structural Engineering education and training should be in consonance with the realisation of national needs and aspirations vis-à-vis industrial development and technological emancipation. The graduates of Structural Engineering must therefore be knowledgeable, creative, resourceful and able to perform the following functions:
1. conducting investigations into structural engineering problems;
2. designing structural engineering projects, systems, machines, equipment and supervising their implementation;
3. designing and developing new products and production techniques in industries;
4. installing and maintaining complex structural engineering systems for optimal performance in our environment;
5. adapting and adopting exogenous technology in order to solve local structural engineering problems;
6. exercising original thought, having good professional judgment and taking responsibility for the execution of important tasks;
7. managing people, fund, materials and equipment;

8. familiarising with all the materials, components, machines, equipment, production techniques and systems in Structural Engineering;
9. manning and maintaining specific production equipment in structural engineering;
10. acquiring proficiency in the useof standards, codes, and modern information and communication technology tools in structural engineering practice;
11. possessing the ability to consider the human, social, environment and sustainability dimensions in finding solutions to complex structural engineering problems;
12. possessing good knowledge of the ethics of the Structural Engineering profession and applying the knowledge as appropriate;
13. working alone or in a team, especially a multidisciplinary team, and also displaying oral and written communication skills; and
14. engaging in lifelong learning for continuous self-improvement.

Employability Skills

The decision to revamp the curriculum of higher education in Nigeria could not have come at a more opportune time. Employability rating of university graduates has been on a steady decline for years. In a bid to stem this negative trend a fresh curriculum is hereby proposed, that will allow universities to contribute a minimum of 30% innovative content to the core of the minimum academic standard prescribed by the NUC. In tandem with this objective, the Structural Engineering CCMAS places a high premium on the following twelve employability skills as its desired programme outcomes in line with global best academic and professional practices:

1. *Engineering Knowledge:* application of knowledge of mathematics, science, engineering fundamentals and an engineering specialisation in solving developmental and complex engineering problems;
2. *Problem Analysis:* identification, formulation, researching literature and analysing developmental and complex engineering problems, reaching substantiated conclusions through first principles of mathematics, natural sciences and engineering sciences;
3. *Design/Development of solutions:* proffering solutions for developmental or complex engineering problems and designing systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental considerations;
4. *Investigation:* conducting investigation into developmental or complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. *Modern Tools Usage:* creating, selecting and applying appropriate techniques, resources and modern Engineering and Structural Engineering tools, including prediction, modelling and optimisation to developmental and complex engineering activities, with an understanding of the limitations;
6. *The engineer and Society:* applying reasoning informed by contextual knowledge including humanities and Social sciences to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice;
7. *Environment and Sustainability:* understanding the impact of professional engineering solutions in societal and environmental contexts and demonstrating knowledge of and need for sustainable development;
8. *Ethics:* applying ethical principles and committing to professional ethics and responsibilities and norms of engineering practice, including adherence to the COREN Engineers Code of Conducts;
9. *Individual and Team Work:* functioning effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings;

10. *Communication:* communicating effectively on developmental or complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions;
11. *Project Management and Finance:* demonstrating knowledge and understanding of engineering, management and financial principles and applying these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments; and
12. *Lifelong Learning:* recognising the need for, and having the preparations and ability to engage in independent and lifelong learning in the broadest context of technological and social changes.

21st Century Skills

The Structural Engineering CCMAS seeks to emphasise the 21st century skills as recommended by the Organisation for Economic Co-operation and Development (OECD). Technical Skills: Structural engineers need to have an in-depth knowledge of the concepts of applied science. A greater understanding of Mathematics and Physics would help them identify and solve complex engineering problems by applying crtical thinking/problem solving/decision making.

Communication Skills: Structural engineers at all levels need to communicate clearly and authoritatively via written reports and correspondence regarding technical specifications and project updates. Engineers with excellent oral and written communication skills can communicate information in a clear and concise way to both technical and non-technical people they work and interact with at all levels.

Collaboration skills through teamwork and ethics/citizenship (local and global), information literacy and learning to learn/metacognition.

Leadership Skills: Structural engineers must possess excellent leadership skills to be able to successfully lead the team towards finishing the project on time and budget. They need to be able to manage, plan and prioritise projects, delegate duties when needed, make decisions with authority, and lead the team members towards steering project outcomes in the right direction.

Analytical Skills: Analytical skills are indeed absolutely vital for structural engineers to successfully handle situations with prompt action. Analytical skills will help them evaluate options and implement cost-effective solutions to handle the complex issues that arise during the planning and construction of projects. They should be able to determine how the existing system should work and how the changes in project operations, working conditions, and the external environment influence and affect the outcome and progress of a project. They should have the ability to harness logical reasoning from situations at hand and identify all possible solutions along with its strengths and weaknesses to keep the project on track.

Project Management Skills: Structural engineers deal with all aspects of project management, which include pre-planning, resource allocation, budgeting, contract negotiation, supervising, and worker coordination. They need to have prowess in managing work materials, tools, and methodology involved in construction and repairs. It is important for structural engineers to be able to escalate any task and manage a diverse team of workers and professionals while staying in compliance with all norms and regulations.

Unique Features of the Programme

The field of Structural Engineering deals with principles and methods for the design of buildings and civil engineering structures. The objective of design is to create structures with adequate safety and serviceability under the influence of the relevant loads and actions during the lifetime of the structure. The education in Structural Engineering covers behaviour, load bearing capacity and methods for the design of structural elements and joints in concrete, steel, timber and masonry. Principles of design and models for loads and actions are also included as well as computer aided draughting and design. Design of structural systems for houses, bridges, tunnels and other civil engineering structures is an important part of the teaching activities. The uniqueness already established for the CCMAS in the engineering and technology discipline totally applies to the Structural Engineering Programme.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**ENT/ GST**	**Basic Sciences**	**Faculty (GET)**	**Departmental (STE)**	***SIWES**	**Total Units**
100	4	16	3	2	-	25
200	4	-	25	-	3	32
300	4	-	15	6	4	29
400	-	-	-	0	8	8
500	-	-	5	6	-	11
Total	**12**	**16**	**48**	**14**	**15**	**105**

* All 15 units of SIWES credited in the 2nd Semester of 400 Level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	
GET 101	Engineers in Society	1	C	15	-
GET 102	Introduction to Engineering Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
STE 102	Introduction to Structural Engineering.	2	C	30	-
	Total Units	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	E	45	-
GET 203	Engineering Graphics and Solid Modelling II	2	C	15	45
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I	3	C	9 weeks	
	Total units	**32**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
STE 303	Structural Mechanics	3	C	45	-
STE 304	Construction Technology	3	C	45	-
STE 306	Principles of Soil Mechanics and Engineering Geology	3	E	45	-
*GET 399	SIWES II	4	C	12 weeks	-
	Total	**25**			

New

400 Level

Course code	Course title	Units	Status	LH	PH
STE 405	Structural Dynamics	3	E	30	45
STE 407	Finite Element Method	3	E	45	-
STE 409	Design of Reinforced Concrete Structures	3	E	45	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
Total		**17**			

***SIWES courses**

Second semester (Student industrial work experience)				
GET 299	SIWES I	3		9 weeks
GET 399	SIWES II	4		12 weeks
GET 499	SIWES III	8	C	24weeks
TOTAL		**15**		

500 Level

Course code	Course title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	
GET 502	Engineering Law	2	C	30	-
STE 501	Steel Structures	3	C	45	-
STE 502	Design and Construction of Tall Buildings	3	C	45	-
	Total	**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional). grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking;

reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;

4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength, cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;

7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;

5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units: C, LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum; and
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents
Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes
On completion, the student should be able to:
1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

STE 102: Introduction to Structural Engineering. (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate that computational procedures are useful in analysing structures;
2. explain structural behaviour;
3. demonstrate an in-depth exposure to computer-based analysis methods;
4. show that computer-based methods can be used to determine, with minimal effort, how structures respond to loads;
5. establish the extreme values of design variables required for design detailing; and
6. develop ability to validate computer-based predictions of structures.

Course Contents

Introduction to scope of Structural Engineering profession: earthquake, environmental, geotechnical, transportation, and water resources engineering and their relationship to civil engineering.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units E: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 203: Engineering Graphics and Solid Modeling II (3 Units C: LH 30; PH 45)

Learning Outcomes

Students should be able to:

1. apply mastery of the use of projections to prepare detailed working drawing of objects and designs
2. develop skills in parametric design to aid their ability to see design in the optimal specification of materials and systems to meet needs.
3. be able to analyze and optimize designs on the basis of strength and material minimization.
4. get their appetites wetted in seeing the need for the theoretical perspectives that create the basis for the analysis that are possible in design and optimization, and recognize/understand the practical link to excite their creativity and ability to innovate. and
5. be able to translate their thoughts and excitements to produce shop drawings for multi-physical, multidisciplinary design.

Course Contents

Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 204: Students Workshop Practice (2 Units C: LH15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal

spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents
Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering **(3 Units C: LH 30; PH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development;

coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: Each programme to indicate additional details of programme-specific activities for their students.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:

1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications;; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and

5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI.; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python "AI" libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, and wooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solid works: software capabilities, design methodologies and applications. Basics part modelling: sketching with Solid Works, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in SolidWorks; and
d. technical report writing.

STE 303: Structural Mechanics (3 Units C: LH 45)

Course Contents

Analysis of stress and strain, phenomenological material behaviour, extension, bending, and transverse shear stresses in beams with general cross-sections, shear centre, deflection of beams, torsion of beams, warping, column instability and failure. Analysis of truss and frame structures using matrix methods; matrix force methods; matrix displacement method; analysis concepts based on theorem of virtual work; moment distribution.

Learning Outcomes

At the end of this course, the students should be able to:

1. determine the design loading on structures using design codes and assessing the load paths for common structural forms;
2. identify points of certainty regarding structures deformation/rotation to qualitatively construct shear force and bending moment diagrams for both statically determinate and indeterminate structures;
3. apply the principle of virtual work to calculate the deflections of truss, beam and frame structures;
4. employ the principles of virtual work and compatibility to evaluate the internal forces and deflections of truss, beam and frame structures; and
5. demonstrate the analysis of both sway and no-sway frame structures using the slope-deflection equations.

STE 304 Construction Technology (3 Units: C: LH 45)

Learning Outcomes

At the end of this course. the students should be able to:

1. introduce and master construction safety precaution and awareness;
2. reinforce basic math skills by incorporation of practical application;
3. identify hand and power tools and describe their uses.
4. introduce the students to reading and interpreting construction blueprints;
5. identify construction materials and describe their uses; and
6. introduce the students to basic skills and knowledge in the fields of rigging, carpentry, electrical wiring, masonry, and plumbing.

Course Contents

Principles of building strength and stability. Site mobilisation, setting out and building process. Types and methods of construction of principal building elements. Basic structural building frames. Elements of industrialised building systems.

STE 306. Principles of Soil Mechanics and Engineering Geology (3 units C: LH 45)

Learning outcomes
At the end of this course, the students should be able to:

1. evaluate and classify soils including soil and water weight-volume relationships;
2. evaluate the state of stress and shear strength of a soil mass;
3. estimate seepage volume and settlement through a compressible soil mass; and
4. find the bearing capacity of shallow and deep foundations.

Course Contents
Soil as a foundation for structures and as a material of construction. Soil formation, classification, physical and mechanical properties, soil compaction, earth pressures, consolidation, and shear strength.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly, and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

STE 405: Structural Dynamics **(2 Units E: LH 30; PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. analyse indeterminate structures and adopt an appropriate structural analysis technique; and
2. determine the response of structures by classical, iterative and matrix methods.

CourseContent

Basic structural dynamics course for Civil Engineering students. Elastic free, forced vibration, and earthquake response spectra analysis for single and multi-degree of freedom systems. Axial, bending, and torsional vibration of beams. Calibration of instrumentation for dynamic measurements. Determination of natural frequencies and damping factors from free vibrations. Determination of natural frequencies, mode shapes, and damping factors from forced vibrations. Dynamic similitude.

STE 407: Finite Element Methods. **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the numerical methods involved in finite element theory;
2. discuss the role and significance of shape functions in finite element formulations and use linear, quadratic, and cubic shape functions for interpolation;
3. apply direct and formal (basic energy and weighted residual) methods for deriving finite element equations;
4. explicate global, local, and natural coordinates;
5. explain the formulation of one-dimensional elements (truss and beam);
6. elucidate the formulation of two-dimensional elements (triangle and quadrilateral continuum and shell elements);
7. discuss the formulation of three-dimensional elements (tetrahedral and brick elements);
8. select appropriate space (planar (plane stress or strain), axisymmetric, or spatial), idealization (type of element), and modelling techniques; and
9. perform and verify finite element analysis (FEA) using commercial FEA software; and
10. recognise sources of errors in FEA.

CourseContents

Direct approach for truss analysis, strong form and weak form, approximation functions for finite element methods, weighted residual methods, Ritz method, variational method, convergence criteria and rate of convergence, natural coordinates and shape functions, iso-parametric finite elements, finite element formulation of multidimensional heat flow and elasticity, numerical integration and approximation properties, finite element formulation of beam.

STE 409: Design of Reinforced Concrete Structures **(3 Units E: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. generalise the guiding principles of the serviceability limit state and the ultimate limit state concepts and how they relate to the design of structures;
2. summarise the fundamental mechanics of reinforced concrete and the empirical assumptions made for analysis;
3. identify reinforced concrete failure modes from crack patterns;

4. apply fundamental mechanics to the design of reinforced concrete beams and slabs at the serviceability limit state including determination of short- and long-term deflection and crack widths;
5. apply fundamental mechanics to the design of reinforced concrete beams and slabs at the ultimate limit state including determination of member strength (flexural and shear) and ductility;
6. apply fundamental mechanics to the design of reinforced concrete columns at the ultimate limit state including determination of strength under uniaxial and biaxial bending; and
7. design basic structural elements (beams, columns and slabs) according to the design approach of internationally acceptable standards.

Course Contents
Beams, columns and slabs in reinforced concrete structures. Properties of reinforced concrete materials. Design of beams and slabs for flexure, shear, anchorage of reinforcement, and deflection. Design of columns for axial force, bending and shear, ultimate strength design methods.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes
At the end of the course, students should be able to:
1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law **(2 Units C: LH 30)**

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/Cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

STE 501: Design and Construction of Steel Structures. **(3 Units C: LH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. learn the basic elements of a steel structure;
2. learn the fundamentals of structural steel fasteners;
3. design basic elements of steel structure like tension members, compression members, beams and beam-columns; and
4. design column splices and bases.

CourseContents
Introduction to building codes. Fundamentals of load and resistance factor design of steel elements. Design of tension and compression members. Design of beams and beam columns. Simple connection design. Introduction to computer modelling methods.

STE 502. Design and Construction of Tall Buildings **(3 Units C: LH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. identify the various types of materials used in tall buildings together with their characteristics;
2. explain wind and seismic effects on behaviour of tall structures;
3. discuss various structural systems of tall buildings constructed using concrete, steel and steel/concrete composite material;
4. analyse the behaviour of various structural systems under gravity and lateral loading along with their advantages and limitations;

5. explain the use of structural engineering software for analysis and design of high-rise structures;
6. explicate the foundation system used for high rise buildings; and
7. elucidate the latest trend in tall buildings in Nigeria and abroad.

Course Contents

Introduction to total design process and professional participants. Systematic presentation of advantages and limitations of different structural forms and systems. Identification of critical design factors influenced by tallness. Foundation systems. Construction site visits, costing, and scheduling.

Minimum Academic Standards

Equipment

Structural Engineering Laboratory

1. Civil engineering materials equipment
2. Routine testing equipment
3. Equipment for models and prototype testing, for example, trusses, columns, beams and frames.
4. Studio/design office.

Geotechnical Engineering Laboratory

1. Field soil survey and testing kits (including sub-soil investigation and drilling)
2. Laboratory soil/rock testing equipment.

Geodetic Engineering & Photogrammetry Laboratory

1. Laboratory equipment stores
2. Photogrammetric and remote sensing laboratory equipment.

Highway and Transportation Engineering Laboratory

1. Highway materials testing laboratory equipment
2. Pavement laboratory equipment

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalents of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical's and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees; hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practical's and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC;

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

University Library

Library books, journals and other resource materials should be adequate in number and currency

Electronic Library

The University library should subscribe to some on-line databases relevant to structural engineering degree programme such as: ASTM standards, ASTM digital library, compendex, Google Scholar, ICE virtual library – Ebooks, and computer-aided Civil and Infrastructure Engineering. Journals subscription should include volumes such as: IEEE Transactions on Intelligent Transportation Systems, Automation in Construction, Building and Environment, Energy and Buildings, Transportation Research Part B, Methodological, Transportation Research Part E, Logistics and Transportation Review, Structural Safety, Journal of Hydrology, and Tunnelling and Underground Space Technology.

Faculty/Departmental Library

A faculty or departmental library should be available for the use of staff and students. Current, local, national and international journals relevant to Structural Engineering should be available e.g. Nigerian Society of Engineers technical transactions, relevant codes and standards should also be available.

List of basic equipment/instruments/machines/tools expected in laboratories/ workshops common to all engineering disciplines

Central Workshop

Fitting and Machining Section

1. workbenches with vices for metal work
2. tool boxes containing hand tools such as screw drivers, wrenches, hammers, hacksaws, files, centre punch chisel, scrapers, etc.
3. lathe machines
4. milling machines
5. power hacksaw
6. shaping machines
7. NC lathe machine
8. NC milling machine
9. drilling machines
10. vernier callipers and micrometer screw gauges
11. sheet metal folding machine
12. grinding machine.

Foundry Section
Furnaces and casting facilities

Welding and Fabrication Section
1. arc welding machines and accessories
2. gas welding facilities
3. safety goggles, eye and ear protectors
4. pop riveting machine
5. guillotine Cutting Machine
6. rolling machine, etc.

Carpentry and Woodwork Section
1. band saw, radial arm saw, circular saw
2. surfacing machine
3. mortise machine
4. thicknessing / Planing machine
5. wood lathe machine
6. portable sander machine
7. jig saw, rip saw, cross-cut saw, panel saw, tenon saw, compass saw
8. drilling machine
9. chest drill
10. spraying machine
11. oil stone
12. wood workbenches with vices
13. G clamp, F clamp, sash clamp
14. jack planes, smooth planes
15. Other hand tools such as tri square, claw hammer, pincer, marking gauge, mortise gauge, spirit level, flat chisel, wood rasp, round chisel, wood mallet, spoke shave, screw drivers, tape rule and scraper.

Electrical/Electronic Section
water distillers

hydrometers
multimeters, voltmeters, ammeters and clamp meters
soldering irons
battery chargers
standard tool boxes for electrical and electronics works
electrical/electronics data books
oscilloscopes
tachometers and phase sequence meters
logic probes
etching machines complete with accessories
coil winding machine.

Thermodynamics and Fluid Mechanics Laboratory

manometers
hydrostatic forces on plane & curved surfaces apparatus
stability of floating bodies' apparatus
laminar and turbulent flow apparatus
temperature measurement apparatus
pressure measurement apparatus
thermal conductivity apparatus
apparatus for flow through nozzle and orifice

Strength of Materials/Materials Laboratory

simple bending apparatus
apparatus for tensile, compression and torsion tests
strain gauges, wheatstone bridge.

Basic Electrical Engineering Laboratory

D. C. and A. C. power supplies
signal generators
function generators
oscilloscopes
voltmeters, ammeters, multimeters
frequency counters
circuit components such as resistors, capacitors, inductors, transistors.
potentiometers.

Teaching Facilities

Classrooms

There should be adequate lecture theatres and classrooms for the programme. At least three adequate and dedicated classrooms should be available with lecture theatres.

Office Accommodation

Offices should be 18.5 m^2 while research laboratory should be 14.5 m^2

Safety, Sanitation and Environmental Sanitation of Teaching Facilities

Buildings should be safe and in compliance with Federal, State and Local Government Laws relating to safety, fire hazards, etc. All buildings should have functional fire-extinguishers, fire buckets with sand, and water source/reservoir and all staff and students should have some knowledge on how to operate all the fire equipment.

Drawing Office and Equipment

There should be space and furniture in the graphics room for at least 20% of the students in 200 Level in the faculty to be able to carry out their drawings at the same time. All the students are expected to own portable drawing boards, instruments and T-square. There should be some provision for computer-aided graphics.

Teaching Aids

The programme should have adequate numbers of projectors installed in the classrooms. There should be good white boards and public address systems for large lecture rooms. Modern facilities such as interactive magic boards are expected in all the lecture rooms. Each student is expected to own and use a computer/lLaptop.

Virtual Laboratory, Simulation Systems and Models

Virtual laboratory facilities, audio-visual recording studio, models, and simulation computer software packages, should be available.

All other items as specified in the Discipline Section.

Classrooms, Laboratories, Workshops, Clinics, and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Systems Engineering

Overview

The content of this curriculum is for Bachelor of Engineering (B.Eng) degree programme in Systems Engineering. Systems Engineering takes a synthetic systems approach to engineering education, and is cognisant of the reality that the typical engineer faces in industry and practice based on the fact that problems are not easily classified into neat compartments that they are used to in the university.

Philosophy

The graduates of this programme will be able to take a multidisciplinary and multiphysical approach to society's challenges from the perspective of providing solutions that are efficient and effective. It will draw on a wide range of physical and scientific knowledge base that were previously seen as distinct – making them into a uniform continuum.

Objectives

The products of this programme will therefore be in a position to:

1. relate easily to the products of several other engineering disciplines such as Mechanical, Civil, Chemical, Electronics and Electrical, Biomechanical and Industrial engineering since they have covered similar scopes of work as these engineers in related fields.
2. function in place of several of these engineering experts because a substantial portion of the essentials of these related fields is covered in a synthetic approach that is inherent in the Systems Engineering approach.
3. bring multi-physical and multi-disciplinary rigour into engineering problem solving and function in mechatronics roles, Software Engineering, AI, machine learning as well as data analytics.

To achieve this end, the department's courses are divided into four broad areas: Multiphysical Design, Artificial Intelligence & Machine Learning, Industrial Systems, Electronics & Controls Systems. The Multiphysical Design area covers the essence of mechanical, thermal and electronics design and analysis in a number of courses by leveraging the Continuum Mechanics approach with a heavy dose of simulation, analysis, prototyping and optimisation relying on modern engineering design tools such as fusion 360 and computational fluid dynamics.

Employability Skills

Employment opportunities for the products of this program covers the entire range of several engineering disciplines including but not limited to: Mechanical, Electrical and electronics Engineering, Information Technology and Software systems, Artificial Intelligence and Machine Learning. They should also be able to play coordinating roles in multifaceted industries where several engineering and science disciplines collaborate to bring solutions. Their training should make them relate seamlessly with various other engineers.

They should therefore be able to pursue careers in traditional as well as non-traditional roles of engineers. They should be able to bring the rigour of software and hardware experience to the modernisation of other disciplines as they rely more on ICT to achieve their objectives.

Small companies will be able to hire them for roles that should have required more than one or two engineers trained in some of the related disciplines.

21st Century Skills

The 21st century skills are as follows:

1. critical thinking/problem solving/decision making;
2. creativity and innovation;
3. learning to learn/metacognition;
4. communication;
5. collaboration (teamwork and ethics);
6. information literacy;
7. growth mindset;
8. computational thinking; and
9. citinzenship (local and global).

Unique Features of the Programme

This program follows the modern trend in unifying the technology approach to problem solving. This has created a number of new fields such as Financial Engineering, and the use of turbulence in areas such as fluid mechanics to model economic systems. This trend will continue. Systems Engineering is a good preparation for our nation to retool and move into the technological trends that makes many nations prosper.

It is our attempt to change the game from trying to catch up with mature technologies to an innovative approach where we play at the point of development of new ways of doing things.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering

degree programme. Such candidates shall have spent a minimum of eight academic semesters

3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	GET	SSG	SIWES courses	Units
100	4	18	3			25
200	4		24	2	3	33
300	4		18	4	4	26
400				9	8	8
500			5	10		13
Total	**12**	**18**	**50**	**25**	**15***	**105**

* All 15 SIWES units to be credited in the 2nd Semester of 400-Level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	
GET 101	Engineer in Society	1	C	15	-
GET 102	Introduction to Graphics and Solid Modelling I	2	C	15	45
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	3	C	45	-
PHY 102	General Physics II	3	C	45	-

PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
	Total	**25**			

200 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
SSG 203	Solid Modelling and Design	2	C	30	-
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**30**			

300 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	-
GET 304	Technical Writing and Communication (including Seminar Presentation	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technology	3	C	45	-
GET 307	Introduction to Artificial Intellegence, Machine Learning and Convergent Technologies	3	C	30	45
SSG 321	Continuum Mechanics I	2	E	30	-
SSG 322	Control Theory I	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	

	Total	**22**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
SSG 415	Mechatronics & Robotics	2	E	30	-
SSG 431	Continuum Mechanics II	2	E	30	-
SSG 433	Introduction to Microelectromechanical Systems	2	E	30	-
SSG 435	Control Systems	3	E	45	-
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**0**			

SIWES Courses*

GET 299	SIWES I: SIWEP	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

* All credited in the 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
SSG 518	Machine Learning & AI	2	C	15	45
SSG 531-	Final Year Project 1	3	C	15	90
SSG 532	Design Simulation, Analysis and Optimization	2	E	15	45
SSG 560	Final Year Project II	3	C	-	135
	Total	**13**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and

7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Major word formation processes; the sentence in English (types: structural and functional). Grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society **(1 Unit C: LH 15)**

Learning Outcomes
At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids

and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II **(1 Unit C: PH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes

At the end of the course students should be able to:

1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents

Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

200 Level

GST 212: Philosophy, Logic and Human Existence **(2 Units C: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

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ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications.

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe basic concepts of thermodynamics, i.e., quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-v-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and

6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;

5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents
Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

SSG 203: Solid Modeling & Design (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. turn engineering artifacts, components, and designs int actionable 3D solid models;
2. animate systems;
3. simulate simple linear systems ; and
4. mix ideas from multiphysical environments into a solution of real life problems.

Course Contents

Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery.
Prerequisite: GET 102

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;

5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 UnitsC: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports.

Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web

technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;

c. part modelling and drafting in SolidWorks; and
d. technical report writing.

SSG 321: Continuum Mechanics I **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. strengthen their background in the basic prerequisites to Continuum Mechanics;
2. master vector analyses, tensor theory and kinematics;
3. develop the ability to use general models and equations that apply to all materials in solid, liquid, gaseous or any combination of forms; and
4. explain the differential and integral formulations of the governing equations.

Course Contents

Mathematical preliminaries for continuum mechanics. Linear Independence, basis vectors, dimensionality. The Einstein summation convention. Scaling, scalar, vector and tensor products. Cartesian and curvilinear orthogonal coordinate systems. Tensors as linear transformations. Tensor invariants. Additive and multiplicative decompositions. Differentiation of vectors and tensors. Gradient, divergence and curl. Integral theorems of stokes and gauss. Use of symbolic algebra and computed graphical illustrations. Thermodynamic laws.

Prerequisite: GET 301, GET 302

SSG 322: Control Theory I **(2 Units E: LH 30)**

Learning Outcomes

At the end of this course, the students should be able to:

1. Explain the differences in frequency and time domain modelling;
2. generate and analyse transfer functions for linear control systems; and
3. familiarise with various methods of analyses and their applications to practical problems.

Course Contents

Dynamic systems. Time domain and frequency domain modelling and response analysis of linear control systems. State Space representations, the exponential matrix and transfer functions. Detailed time response analysis of linear second order control systems. Routh's method for determination of BIBO stability of linear control systems. Steady State Error Analysis and Design of Feedback Control Systems. Discrete time analysis for digital control systems.

400 Level

SSG 415: Mechatronics and Robotics **(2 Units E: LH 30)**

Learning Outcomes

At the end of the course, students should be able to:

1. visualise how robots are embodiments of the Artificial intelligence they have learned.
2. comprehend how this combination of programming with electronics and
3. mechanical systems enable them to see how in real life these all work together to provide solutions to problems encountered in daily life as distinct from the analytical approach of seeing these differently.

Course Contents
Introduction to mechatronics, robotics and measurement systems. Design and development of simple mechatronics/robotics systems. Analysis and design of sensor and actuator systems. Solenoids, relays, motors, pneumatics, and smart actuators. Class project.

SSG 431: Continuum Mechanics II (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. derive the integral as well as differential forms of the governing equations of continua that arise from natural balances;
2. apply these equations to fixed control volumes and moving masses that convect with systems; and
3. apply these equations to solid bodies, fluid bodies and combinations of these.

Course Contents
Referential and spatial descriptions of deformation and motion. Polar decomposition theorem. The deformation gradient and other measures of shape changes. Material and spatial time derivatives. Referential and spatial gradients. Leibniz-Reynold's transport theorem. Theory of stress and heat flow. Cauchy's lemma. Cauchy stress law, balance laws of mass, momentum and energy. The second law of thermodynamics. Introduction to constitutive modelling.
Prerequisite: SSG 321

SSG 433: Introduction to Micro-electromechanical Systems (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. design electronics controls for mechanical systems;
2. model and simulate systems that combines mechanical, electrical and electronics aspects; and
3. analyse, design and simulate multiphysical systems.

Course Contents
Overview of microelectromechanical systems (MEMS). Use of MEMS with radio frequency, optical and biomedical devices. Basic MEMS building blocks; cantilever and clamped-clamped beams. Actuation mechanisms of mechanical, thermal and electrostatic microdevices. The thin film fabrication process, deposition, lithography, etching and release. MEMS in circuits, switches, capacitors, and resonators.

Prerequisites: SSG 350, SSG 321. Corequisite SSG 438

SSG 435: Control Systems & Applications (3 Units E: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. design linear and non-linear filters and regulators
2. optimize autonomous systems, and
3. decide on optimal solution techniques

Course Contents

Introduction to optimum systems control problems in engineering. Calculus of extrema and single-stage decision processes. State estimation techniques and design of linear filters. Vibrational calculus and continuous optimal control. Design of Linear Quadratic Regulators; the minimum time, minimum fuel, and minimum energy control policies. The maximum principle and Hamilton Jacobi theory. Applied optimum systems control examples.

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of ontract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

SSG 518: Machine Learning & AI **(2 Units C: LH 15; PH45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the use of AI as an intelligence augmentation tool;
2. discuss deep learning, its scope, achievements, limitations, and failures; and
3. use AI and ML software to augment intelligence and solve practical problems.

Course Contents
Introduction to search methods in Artificial Intelligence problems. Self-organizing systems. Information theory, rational decision making and pattern recognition. Parametric and nonparametric training for pattern classifiers. Problem solving. Minimax and alpha-beta algorithm. Heuristic approaches to state-space search problems.
Prerequisite: SSG 311

SSG 531: Final Year Project 1 **(3 Units C: LH 15; PH 90)**

Learning Outcomes
At the end of this course, the students should be able to:
1. complete the proposal, evaluation, and design phase of a capstone project;
2. demonstrate the connection between the chosen problem and a number of theory courses they have taken;
3. perform an evaluation of the needed supply and support for the capstone project; and
4. present their proposals to a committee of advisers.

Course Contents
The students, preferably working in groups, should select and do preliminary work on a capstone project in one or more of the base teaching areas of Systems Engineering. The students can also go beyond the department and engage in multidisciplinary undertakings provided permission is obtained from the HoD through the assigned project advisor. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent in the first semester.

SSG 532: Design Simulation, Analysis and Optimization
(2 Units E: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. analyse design alternatives using finite element tools to solve the differential equations that arise from the combination of general balance laws and the specific constitutive models;
2. perform linear analysis and simulation; and
3. optimise design for material reduction and strength maximization.

Course Contents
Computer graphics for modelling, design, and analysis. GUI based interaction with graphic design software. API graphics programming using Python or C++. Introduction to design applications in finite elements using computational fluid dynamics and multiphysical simulation for linear and nonlinear constitutive models; simulation and analysis tools such as

fusion 360, NASTRAN, ANSYS, or solid works. Graphics for scenario analysis automation and optimization. Design project.

Prerequisite: SSG 431

SSG 560: Final Year Project II **(3 Units C: PH 135)**

Learning Outcomes

At the end of this course, the students should be able to:

1. complete the design phase of the capstone project begun in SSG 530;
2. implement the design by analysis, optimisation and prototyping; and
3. demonstrate the connection between product-making and the theory courses they have learned.

Course Contents

The design, execution phase of the capstone project. This could include analysis, simulation and or prototyping. For students in a multidisciplinary project, deep dive into the way theory interacts with design and prototyping decisions is essential.

Prerequisite: SSG 530.

Minimum Academic Standards

Equipment

Laboratory Equipment Requirements

List of Laboratories/Workshop

Microprocessors Laboratory
controls laboratory
robotics laboratory
software development laboratory

List of Major Equipment

Testing Laboratory

1. Universal testing machine with accessories for tension, compression, transverse 180° cold bend, double shear, punching and brunel hardness tests. Capacity – 10000KN, Transverse Beam – 500KN.
2. Proto-type tests facilities for testing of proto-type in structural elements, i.e. beams, frames, trusses, etc. accessories for the purpose include 1000KN, 250KN load rings, electronic load cells, faculty workshop facilities, DEMEC high accuracy auges, hydraulic jacks
3. Fatigue and microtesting machine.

Software Development Laboratory

high speed graphics capable computers and single board computers.

Controls Laboratory

Artificial Intelligence and Machine Learning Laboratory

Manufacturing Laboratory

1. 5-axis CNC machine
2. 3-printers (1 to 20 students)
3. laser cutter

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC;

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

Library Facilities

The following facilities should be provided to enable users make maximum use of library services:

1. reading rooms
2. 24-hour reading rooms
3. Visually impaired resource centre
4. radio frequency identification (RFID) security gate for theft detection
5. RFID tags for book tagging
6. Notebook computers for loan service
7. over two hundred computers distributed at the various service points for database search at the university library and faculty libraries
8. workstations at the faculty libraries for database search
9. projectors and creens for presentations
10. photocopying machines
11. scanners
12. visually impaired resource centre
13. information display screen

Classrooms, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m²**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Telecommunications Engineering

Overview

Telecommunication Engineering involves the design, construction, installation, operation and maintenance of telecommunication systems, components or processes to meet desired needs while considering economic, environmental, social, ethical and sustainability constraints. The programme incorporates strong elements of electrical and electronics engineering. It allows graduates to address a wide range of applications, which require in-depth knowledge of electronics, modern computer technologies, and software and information systems. Consequently, the programme is designed to expose students to telecommunications systems encompassing both hardware and software needed by professional engineers in telecommunications systems.

The early introduction to scientific and engineering foundation of Computing, Electronics, Physics and Mathematics prepares the ground for introduction to the specialised telecommunications engineering courses including telecommunications systems modelling, computer networks, voice telecommunications and emerging technologies including 3G video phones, high speed domestic broadband and network security. Relevant technologies include: complex electronic switching systems, transmission systems from copper wires to optical fibre, satellites, cellular networks, Internet Protocol networks and digital television; digital representation of audio, video and other multimedia; and the control, design and analysis of massive communications networks.

Philosophy

The philosophy of the Telecommunications Engineering programme is to develop enterprising professionals who have an innovative disposition, the confidence and abilities to assume leadership roles in technology, business and the community. The programme is designed to give the skills essential for the graduate engineers to become immediately employable in the global competitive environment. Emphasis is placed on underlying principles and techniques so that graduates will be able to learn and apply new technologies as they emerge in the future.

Objectives

The objectives of the programme include:

1. imparting a sound knowledge in Telecommunications Engineering and Technology, including design and maintenance of telecommunications equipment and facilities, Software Engineering, systems analysis and design, as well as the dissemination of mathematical skills necessary for applying scientific solutions to problems;
2. producing graduates that will meet Nigeria's need for telecommunication systems engineers with employment prospects in manufacturing and production industries, research and educational establishments, government services;
3. producing graduates that can effectively set up on their own through the entrepreneurial training facilities they have been exposed to;
4. being able to design solutions for complex engineering problems and design telecommunication systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations;
5. being capable of investigating telecommunication engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and

interpretation of experimental data, and synthesis of information to derive valid conclusions;

6. creating, selecting and applying appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations;

7. being able to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to telecommunication engineering problems;

8. working effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings; and

9. recognising the importance of lifelong learning, and pursuing lifelong learning in the broader context of innovation and technological developments.

Unique Features of the Programme

1. The programme offers the opportunity to develop relevant skills necessary to be at the forefront of the ever-expanding field of telecommunications. Its unique features include:
2. development of essential digital skills for the needs of the telecommunications industry;
3. exposure to both hardware, software and collaborative tools needed by professional engineers;
4. equipping graduates for competitive entry into the engineering technology workforce with practical knowledge of existing telecommunications systems;
5. student-centered learning process, infused with entrepreneurial mindset, that will lead to start-ups in the telecommunication sector; and
6. engagement of 21st century skills to cope with emerging technologies in the telecommunications sector.

Employability Skills

The programme will inculcate the following employability skills in graduates:

1. ability to configure, apply test conditions, and evaluate outcomes of experimental systems;
2. ability to design systems, components, or processes that conform to given specifications and cost constraints;
3. in-depth ability to use a combination of software, instrumentation, and experimental techniques practised in circuits, physical electronics, communication, networks and systems, hardware, programming, and computer science theory;
4. ability to work cooperatively, respectfully, creatively, and responsibly as a member of a team;
5. ability to identify, formulate, and solve telecommunication engineering problems;
6. ability to communicate effectively by oral, written, and graphical means;
7. an awareness of global and societal concerns and their importance in developing engineering solutions;
8. understanding the norms of expected behaviour in telecommunication engineering practice and their underlying ethical foundations;
9. knowledge of contemporary issues; and
10. ability to independently acquire and apply required information, and an appreciation of the associated process of life-long learning.

21st Century Skills

The 21st century skills includes:

1. creativity and innovation;
2. critical thinking/problem solving/decision making;
3. learning to learn/metacognition;
4. collaboration (teamwork and ethics);
5. computational thinking;
6. information literacy;
7. leadership: lead diverse teams; integrate knowledge and content across sectors;
8. make ethical decisions: navigate ethically challenging professional situations;
9. communicate effectively: translate concepts across disciplines; and
10. work in cross-disciplinary teams: work in cross-disciplinary teams, understand and promote diversity in the workplace through conscientious decisions and initiatives;

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.

5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	**GST**	**Basic Science**	**Faculty (GET)**	**Programme (TEE)**	**SIWES Courses***	**Total units**
100	4	18	3	2	-	27
200	4	-	23	-	3	30
300	4	-	17	3	4	28
400		-	-	3	8	11
500		-	3	6	-	09
Total	**12**	**18**	**46**	**14**	**15**	**105**

* All 15 units of SIWES credited in the 2^{nd} Semester of 400-Level

100 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Chemistry Practical I	1	C	-	45
CHM 108	General Chemistry Practical II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
MTH 103	Elementary Mathematics III	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	45
TEE 102	Introduction to Telecommunications Engineering	2	C	30	-
	Total	**27**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 207	Applied Mechanics	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Wks	
	Total	**27**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
GET 301	Engineering Mathematics III	3	C	45	-
GET 302	Engineering Mathematics IV	3	C	45	
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics	3	C	45	-
GET 306	Renewable Energy Systems and Techniques	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
TEE 301	Communication Principles	2	C	30	-
EEE 311	Electric Circuit Theory	2	E	30	-
EEE 321	Analogue Electronic Circuits I	2	E	30	-
EEE 322	Digital Electronic Circuits	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Wks	
	Total	**24**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
TEE 401	Digital Systems Design with VHDL	3	C	30	45
TEE 403	Assembly Language Programming	3	E	30	45
EEE 403	Digital Signal processing	2	E	30	-
TEE 405	Digital Communication Systems	2	E	30	-

*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Wks	
	Total	**3**			

SWEP and Student Industrial Work Experience Scheme (SIWES)					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 299	SIWES I: SWEP	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24 weeks	
Total SIWES Units		**15***			

* All credited in the 2nd Semester of 400-Level

500 Level

Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TEE 501	Telecommunications Systems Planning	2	C	30	-
TEE 502	Optical Communication Systems	2	C	30	-
TEE 503	Mobile Communication System	2	E	30	-
	Total	**9**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). major word formation processes; the sentence in English (types: structural and functional); grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;

9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents

Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry)

(2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102 Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;

5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 103: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:
1. solve some vectors in addition and multiplication;
2. calculate force and momentum; and
3. solve differentiation and integration of vectors.

Course Contents

(Pre-requisite –MTH 101)

Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola.
Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102 : General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

TEE 102: Introduction to Telecommunications Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the field of telecommunication and its relationship with other branches of Electrical Engineering;
2. describe the various types of signals and waveforms;
3. explain the concept of time and frequency representation of signals;
4. compare various transmission media for telecommunication signals;
5. appreciate networking services and their impact on society; and
6. discuss the basic switching schemes.

Course Contents

Introduction to Telecommunication; relationship with other fields of Engineering. Taxonomies of telecom systems; signal waveforms and information, audio, data, video; conversion of sound to electrical signals; amplitude, frequency, phase, wave-shape, the relationship between velocity (v), frequency (f) and wavelength (λ). Analog and digital signals, time and frequency domain representations of signals; transmission of signals through various media; copper pairs, coaxial, waveguides, radio, optical fibres and satellite. Introduction to networks services and their impact on society, LANs, MANs, and WANs. Data networks; the internet, global navigation. Electromagnetic spectrum and frequency allocation for various services; basic principles of switching; space and time division switching networks; store-and-forward switching; examples of switching systems.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;

5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units C: LH 30; PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course content

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass –

ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test, impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.

Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 206: Fundamentals of Engineering Thermodynamics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:
1. describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2. define and explain system (surrounding, closed and open system), control volume and control mass, extensive and intensive properties;
3. calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;
4. evaluate the properties of pure substances i.e. evaluate the state of the pure substances such as compressed liquid, saturated liquid-vapour mixture and superheated vapour using property diagrams and tables; arrange the ideal and real gas equations of state,
5. formulate the first law of thermodynamics for a closed system i.e. organize the change in energy in the closed systems via heat and work transfer;
6. distinguish heat transfer by conduction, convection and radiation, and calculate the amount of heat energy transferred;
7. calculate the changes in moving boundary work, spring work, electrical work and shaft work in closed systems;
8. apply the first law of thermodynamics for closed systems and construct conservation of mass and energy equations;
9. formulate the first law of thermodynamics to the open systems i.e. describe steady-flow open system, apply the first law of thermodynamics to the nozzles, diffusers, turbines, compressors, throttling valves, mixing chambers, heat exchangers, pipe and duct flow;
10. construct energy and mass balance for unsteady-flow processes;
11. evaluate thermodynamic applications using second law of thermodynamics;
12. calculate thermal efficiency and coefficient of performance for heat engine, refrigerators and heat pumps; and
13. restate perpetual-motion machines, reversible and irreversible processes.

Course Contents

Basic concepts, definitions and laws (quantitative relations of Zeroth, first, second and third laws of thermodynamics). Properties of pure substances: the two-property rule (P-V-T behaviour of pure substances and perfect gases); state diagrams. The principle of corresponding state; compressibility relations; reduced pressure; reduced volume; temperature; pseudo-critical constants. The ideal gas: specific heat, polytropic processes. Ideal gas cycles; Carnot; thermodynamic cycles, turbines, steam and gas, refrigeration. The first law of thermodynamics – heat and work, applications to open and closed systems. The steady flow energy equation (Bernoulli's equation) and application. Second law of thermodynamics, heat cycles and efficiencies.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:
1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;

5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents
Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents
Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;

3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: Each programme to indicate additional details of programme-specific activities for their students.

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes

At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;

2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies).

Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 301: Engineering Mathematics III (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. demonstrate a clear understanding of the course content, that is, possess a breadth of knowledge in the area covered;
2. possess an in-depth knowledge upon which a solid foundation can be built in order to demonstrate a depth of understanding in advanced mathematical topics;
3. develop simple algorithms and use computational proficiency;
4. write simple proofs for theorems and their applications; and
5. communicate the acquired mathematical knowledge effectively in speech, writing and collaborative groups.

Course Contents
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 302: Engineering Mathematics IV (3 Units C: LH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. solve second order differential equations;
2. solve partial differential equations;
3. solve linear integral equations;
4. relate integral transforms to solution of differential and integral equations;
5. explain and apply interpolation formulas; and
6. apply Runge-Kutta and other similar methods in solving ODE and PDEs.

Course Contents
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturn-Louville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of

finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;

4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes

At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in SolidWorks; and
d. technical report writing.

TEE 301: Electromagnetic Fields and Waves (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. state and explain the various electromagnetic laws;
2. derive and explain Maxwell's equation in rectangular coordinates; and
3. explain wave propagation mechanism in conductors and unbounded dielectric media.

Course Contents

Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell's equation (in rectangular co-ordinates and vector-calculus notation): derivation of Maxwell's equations; electromagnetic potential and waves; Poynting vector; boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media.

EEE 311: Electric Circuit Theory **(2 Units E: LH 30)**

Learning Outcomes
Students will be able to:
1. state, explain and apply circuit theorems to d.c. circuits;
2. obtain the network response to certain input signals using phasor notations and diagrams;
3. state and apply Laplace transforms to solve passive circuits; and
4. plot Bode diagrams of a given transfer function

Course contents
Passive circuit elements: R, L, C, transformers; circuit theorems: Ohm's, KVL, KCL, loop current, node potential, superposition. Network response to step, ramp and impulses. Network functions: response to exponential, sinusoidal sources. Laplace transform and transfer functions: pole-zero configuration and application in solving circuits, resonance; two-port analysis and parameters.

EEE 321: Analogue Electronic Circuits **(2 Units E: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. classify, describe and discuss the principles of operation and applications of FET and BJT;
2. calculate amplifier parameters; and
3. design simple amplifiers using BJT and FET with given specifications.

Course Contents
Review of single-stage transistor amplifiers using BJT and FET equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational amplifiers: description, parameters and applications. Feedback, broadband and narrowband amplifies. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi storage amplifiers using BJTs and FETs.

EEE 322: Digital Electronic Circuits **(2 Units E: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. classify, describe and discuss the various logic gates and flip-flops and multivibrators;
2. apply logic simplification schemes in digital circuits; and
3. design simple logic and sequential circuits using logic gates and flip-flops.

Course Contents
Number systems and codes. Logic gate simplification of logic expressions using Boolean algebra. Simplification of logic expressions using Karnaugh method. Design of combinational circuit. Flip-flops. application of flip-flops in the design of counters, registers and timers. Switching and wave shaping circuits. Generation of non-sinusoidal signal (multivibrators). Introduction to ADC and DAC. Design of logic gates (Diode, DTL, TTL, ECL etc). Sequential circuits. Introduction to microprocessors.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes

Students on Industrial Work Experience Scheme (SIWES) are expected to:

1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

TEE 401: Digital System Design with VHDL (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe finite state machine and its applications in designing digital circuits;
2. build advanced digital logic circuits by applying various reduction techniques and schemes;
3. operate, debug, simulate and analyse complex digital designs in modern VHDL software;
4. analyse and synthesise digital circuits using commercially available VHDL software;
5. create FPGA designs and implement state-of-the-art ASIC/FPGA design methodologies for computer-aided design of logic circuits; and
6. demonstrate practical skills in designing, synthesising and simulating digital systems.

Course Contents

Finite state machine: definition, Mealy and Moore models, state diagram, state table, transition table. Sequential circuits design using flip-flops; asynchronous, and synchronous circuit design. Algorithm State Machine. Design examples and exercises. Structured design: design constructs, design levels, geometry-based interchange formats, computer aided electronic system design tools, Sshematic circuit capture, hardware description languages, design process (simulation, synthesis), structural design decomposition. Introduction to

VHDL: VHDL language abstractions, design hierarchies, VHDL component, lexical description, VHDL source file, data types, data objects, language statements, concurrent VHDL, sequential VHDL, advanced features of VHDL (library, package and subprograms). Structural level modelling, register-transfer level modelling, FSM with data path level modelling, algorithmic level modelling. Introduction of ASIC, types of ASIC, ASIC design process, standard cell ASIC synthesis, FPGA design paradigm, FPGA synthesis, FPGA/CPLD architectures. VHDL design: top-down design flow, verification, simulation alternatives, simulation speed, formal verification, recommendations for verification, writing RTL VHDL code for synthesis, top-down design with FPGA. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer-aided design of logic circuits.

TEE 403: Assembly Language Programming (3 Units E: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. describe the underlying principle in machine-level data representations, computing, and programming;
2. gain proficiency in assembly programming for the x86 architecture, including register operations, control structures, bitwise operations, and subprograms;
3. perform tasks like compiling, linking, loading, and debugging;
4. build a program on a microprocessor using arithmetic and logical instruction set of 8086;
5. analyse abstract problems and apply a combination of hardware and software to address the problem; and
6. review design issues when generating complex digital systems (including microprocessors) and resolve them.

Course Contents

Introduction: language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, program control, machine control, input/output , etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C. Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

EEE 403: Digital Signal Processing (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the Fourier transform and its application in networks;
2. synthesize analogue and digital filters from network function; and
3. explain basic image processing concepts.

Course Contents

Discrete signals and Z-transform, digital Fourier transform, fast Fourier transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; computer techniques in filter synthesis, realisation of filters in hardware and software. Basic image processing concepts.

TEE 405: Digital Communication Systems (2 Units E: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the concept of random processes and their parameters;
2. discuss the Hilbert transform and Markov processes and their application in digital systems; and
3. discuss the different types of digital modulation techniques and their characteristic features, including spread spectrum schemes;

Course Contents

Review of probability: basic concepts. Conditional and total probability. Distribution and density functions. Random variables: single and multiple variables. Mean variance and moments. Basic concepts, definition, and classification of random processes. Stationary process and independence property. Autocorrelation and correlation functions. Ergodicity. Power density spectrum. Linear systems. Hilbert Transforms. Noise modelling. Linear system response to random signal. Narrowband, bandlimited and bandpass processes. Optimal linear systems: matched filter for white noise and coloured noise, Wiener filters, minimum mean-squared error. Optimisation by parameter selection. Poisson points and renewals. Markov processes. Applications of random signal theory in communications. Digital modulation techniques: ASK, FSK, PSK, DPSK, M-ary modulation, continuous phase FSK, MSK, QAM, DSL Schemes. Line coding, intersymbol interference (ISI), Nyquist wave shaping, eye pattern, adaptive equalisation. Transmission over bandpass channel. Spread spectrum communications: pseudo noise sequences, direct sequence spread spectrum, frequency hopping spread spectrum, CDMA, application examples.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons –

functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes
Students will be able to:
1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

TEE 501: Telecommunications Systems Planning (2 Units C: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe the telecommunications standard and regulatory issues;
2. explain network planning and dimensioning to minimize data loss and delay;
3. explain spectrum management and regulatory body involvements;
4. discuss radio planning, spectrum policy and allocation procedures at various levels; and
5. discuss the role integrated data and environment in networks for optimum performance.

Course Contents

Telecommunications standards, monitoring and regulation: International Telecommunications Union (history, structure and functions). Global telecommunications standards collaboration: international and regional. Nigerian Communications Act. Nigerian Communications Commission. Spectrum Management: basics of spectrum management: RF spectrum, classifications and features, spectrum utilization, need for spectrum management, spectrum management goals. Spectrum management functions. Spectrum policy, planning and assignment: frequency assignment and allocation procedures, national, regional and international spectrum management regulatory frameworks. Spectrum management applications (e.g. aeronautics, radio astronomy, radar, broadcasting, satellite networks, etc.). Spectrum management responsibilities: spectrum management improvement techniques, ITU's radio regulation and recommendations, ITU-R activities and study groups, CEPT, ETSI, NTIA, Ofcom, Nigerian Communications Commission (NCC), spectrum management in selected developing countries.

TEE 502: Optical Communication Systems (2 Units C:LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the configuration and architecture of optical communication system;
2. analyse system based on important parameters for characterising optical fiber, optical source, detector and amplifier;
3. analyse the techniques and design methodology of optical fiber system, calculate and simulate the important design parameters; and
4. describe the high-bit-rate data transmission and free-space optical communications systems for deep space application.

Course Contents

Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, coupling/deep space communication system/capacity, reliability economy/application of PCM and A DPCM concepts.

TEE 503: Mobile Communication Systems (2 Units E: LH 30)

Learning Outcomes

At the end ot this course, the students should be able to:

1. state the evolution of mobile networks;
2. explain the basic cellular system and its characteristics and parameters;
3. state international standards and regulations;
4. discuss the frequency management mechanisms; and
5. discuss field strength prediction models and their attributes.

Course Contents

Evolution of mobile radio communications: 1G, 2G, 3G, 4G and 5G. Examples of mobile radio systems: radio paging, cordless telephones, cellular radio. Trends in cellular radio and personal communication systems. A basic cellular system, frequency reuse, roaming, hand-off strategies, co-channel interference, traffic and grade of service, system capacity, improving capacity of cellular system. Doppler effect. Co-channel interference and reduction; adjacent channel interference; near-far problem. Standards and overview of analogue and digital cellular systems; frequency management and channel assignment, speech coding, channel coding, bandwidth consideration, equalisation, modulation techniques, multiple access techniques. GSM: architecture, elements, and standard interfaces; FDMA/TDMA structure; speech and channel coding; time slots and bursts; signaling; hand-offs; DCS

1800; GPRS; data services over gsm. Field strength prediction models, propagation path loss, multipath propagation problem, Rayleigh fading, Rician distribution. Other applications of wireless communications, especially in the financial sector.

Minimum Academic Standards
Equipment
Computer Laboratory (Hardware and Software)

1. Control and instrumentation laboratory
2. Electronics and telecommunication laboratory
3. Signal processing laboratory
4. Data communication and internetworking laboratory
5. Communication systems aboratory
6. RF microwave laboratory
7. Antenna laboratory.

Intermediate Network Laboratory

S/n	Description of Equipment
1	D3000 Virtual Instrument Platform (VIP2)
2	D3000 9.0 Experimental Master PCB
3	D3000 21.1 AM Communications PCB
4	D3000 21.2 Superhet Receiver PCB
5	D3000 21.4 Digital Communications PCB
6	D3000 21.5 PAM PCB
7	D3000 21.8 PCM PCB

Transmission Laboratory

S/ N	Description of Equipment
1	Ctl Modicom 1 "Signal sampling and reconstruction module"
2	02 Modicom 2 "Time division multiplexer PAM Module"
3	CT3/1 and CT3/2 Modicom 3 "pulse code modulation Transmitter/Receiver
4	CT4 Modicom 4 " Delta modulation Module"
5	CT5/1 and CT5/2 Modicom 5 " Data conditioning and carrier modulation
6	CT7 Audio Input Module
7	CT8 Audio Output Module
8	CT20 Anacom 1/1 and ***V2*** "Introductory Analogue Communication Module"
9	CT21 Anacom 2"Introductory Analogue Communication Module"
10	CT30 Transmission Line Trainer
11	Digital Communication System Trainer
12	Analog Communication System Trainer
13	PS20 Power Supply
14	FG2 Function Generators
15	OSC1 Oscilloscopes

Fiber Optic Laboratory		
S/N	**Description of Equipment**	
1	06 Modicom 6 "Fiber-Optic Transmitter/Receiver system"	
2	NTC-1 03.000 "Fiber-Optic Communication" Training stand	
3	Pulse Semi-conductor Laser	
4	Photodiode Current Meter	
5	Continuous Semiconductor Laser	
6	Current Generator	
7	Fast Photo detector	
8	Stand to study photo detector operation	
9	Optical Fiber Coupler	
Microwave Laboratory		
S/N	**Description of Equipment**	
1	CT60 Microwave Communications Trainer: Receiver Transmitter Probe	
2	Spectrum Analyzer " 9kHz -3GHz	
3	Indoor TV Antenna	
4	NTC-1 04 " Radio Engineering & Telecommunication with MPMS"	
5	Microwave Trainer MST 532	
6	Microstrip Trainer MNT 530	
7	18GHz Spectrum Analyzer	
8	18GHz Network Analyzer	
Networking Laboratory		
S/N	**Description of Equipment**	
1	NTC-1 42.000 "Global, Local, Wired & Wireless Networks" Training stand	
2	D-Link Switch	
3	Cisco 1 900 Router	
4	D-Link Router	

Basic Electronic Equipment

1. Frequency meter
2. Digital energy meter
3. Digital wattmeter, single phase
4. Digital wattmeter, 3-phase
5. Semiconductor curve tracer
6. Digital transistor tester
7. Decade resistance box
8. Decade capacitance box
9. Decade inductance box
10. Digital multifunction documenting calibrators
11. Digital function generator (different frequency ranges)
12. Electrical tools box

13. Digital stroboscope
14. Digital DC A ammeters multi-range
15. Digital AC voltmeters multi range
16. Digital DC volt meters multi range
17. Digital DC volt meters multi range
18. Digital damp meter
19. Standard digital earth loop/PSC/tester
20. Photo/contact tachometer
21. LCD Display 3-phase rotation tester
22. Rheostat (different ranges)
23. Wheatstone bridge
24. Portable DC potentiometer
25. Analog dual oscilloscopes (different frequency ranges)
26. Signal trace/Injector
27. Digital RF signal generators
28. Klystron microwave trainer complete set
29. Antenna laboratory trainer complete set
30. PCB Fabrication equipment complete set
31. Standard analog multimeters
32. AVO meters
33. Digital logic analyzer
34. Smart logic design experimental Kit
35. Digital logic circuit design experiment kit microcomputer trainer
36. GSM/GPS experimental trainer
37. Programmable logic controller system trainer
38. Digital 3 phase power analyzer with SD card real time data recorder
39. Digital storage color display 2/4-channel oscilloscope
40. Digital spectrum analyzer (9kHz -3GHz)
41. Instrumentation trainer using transducers complete set
42. Solar power system training kit
43. Electrical and electronic system trainer
44. Power electronic training system
45. Programmable dual output DC power upply units (different ranges)
46. Variable transformer
47. Portable wind power generator training kit universal EPROM programmable (48 Pins)
48. B ench digital multi-meter digit (various digit ranges)

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC;
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio
The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level

Library

Library and Information Resources

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers

Library Facilities

The following facilities should be provided to enable users make maximum use of library services:
a. Reading rooms
b. 24-hour reading rooms
c. Visually impaired resource centre
d. Radio frequency identification (RFID) security gate for theft detection
e. RFID tags for book tagging
f. Notebook computers for loan service
g. Over two hundred computers distributed at the various service points for database search at the university library and faculty libraries
h. Workstations at the faculty libraries for database search
i. Projectors and creens for presentations

j. Photocopying machines
k. Scanners
l. Visually impaired resource centre
m. Information display screen
n. E-library (postgraduate and undergraduate sections)

Classroom, Laboratories, Workshops, Clinics and Offices

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Water Resources Engineering

Overview

Water Resources Engineering involves the application of engineering sciences and ecological principles to the study of hydrological and hydraulic of watershed flow systems which can be used as input into the design of water management systems and strategies. The management of water includes: regulation of water flow rate through hydraulic turbines for electric power generation; flood prevention, warning and control; erosion prevention and control; drainage; design of natural channels, and treatment and supply of water for municipal, industrial and agricultural purposes. This programme is also concerned with identifying potential point and diffused sources of pollutants so that efficient environmentally-friendly and economical methods can be developed to treat or preserve the water for it to be of sufficiently high quality to sustain human life and water dependent ecosystems.

Philosophy

The programme aims to produce graduates who are versed with broad knowledge, understanding and skills in water resources systems design, operation and management. The programme provides the essentials in beginning a professional carrier development, consultancy and employment in public service, private sector and nongovernmental organisations.

Objectives

In line with its philosophy, the objectives of the Water Resources Engineering programme are to:

1. develop and apply essential concepts, theories and principles of engineering and its underpinning science and mathematics to water resources problems;
2. analyse processes driving the hydrological cycle and the physico-chemical processes associated with water and wastewater treatment;
3. plan, design, construct, operate and maintain water diversions, storage, supply and control structures;
4. plan and design water distribution systems, sanitary and storm water collection systems, and the pumping and storage infrastructure required by these systems;
5. manage rivers and reservoirs for recreation, flood control, irrigation, and other multi-use functions;
6. develop groundwater resources and remediate polluted groundwater resources;
7. perform engineering activities by fulfilling legal requirements governing engineering practice; and
8. use specific computer software in design and analysis of water resources systems.

Unique Features of the Programme

The unique features of the curriculum include:

Digital literacy: The curriculum incorporates significant digital programmes for graduates to remain competitive within today's digital economy. Competency based outcome: establishes the desired knowledge, skills, and behaviours of a graduating students that enable them to successfully perform in professional, educational and other contexts.

1. focus on learning: the curriculum is devised to focus on learning to enhance the learning experience of the students by integrating diverse techniques and complementary technologies.
2. entrepreneurial skills for knowledge based and digital economy.

3. collaborative: the curriculum provides for collaboration with the industry in order to realise the much-needed practical knowledge and skills required to take on the present-day challenges

Employability Skills

Graduates of Water Resources Engineering programme are actively sought by employers in both the private and public sectors. Potential employers include large and small businesses, government at all levels, national and multinational corporations and universities. Self-employment as engineering consultants and other technically applied positions is an expanding career option for water resource engineering professionals.

Water Resources engineering graduates will be equipped with the following employability skills:

1. communication skills: the ability to present ideas effectively with confidence through aural, oral and written modes, not only with engineers but also with the community at large;
2. information literacy: The ability to access, evaluate, synthesise and share information from multi-disciplinary / interdisciplinary sources;
3. competence in application and practice: the ability to use techniques, skills, and modern engineering tools for solving engineering problems;
4. team working skills: the ability to function effectively as an individual and in a group with the capacity to be a leader as well as an effective team member;
5. problem solving and decision-making skills: the ability to solve engineering problem through critical thinking, system thinking and effective decision making;
6. engineering System Approach: the ability to utilize systems approach to design and evaluate operational performance;
7. knowledge of contemporary issues: the ability to continue learning independently in the acquisition of new knowledge, skills and technologies. The use of information, communication and computing technologies are very essential in the knowledge-based era; and
8. understand professional, social and ethical responsibilities: the ability to understand the social, cultural, global and environmental responsibilities of a professional engineer, and commitment to professional and ethical responsibilities.

21st Century Skills

The programme will lead to the development of the following 21st century skills:

1. professional and interpersonal skills with competence in the areas of professionalism and teamwork.
2. business and management skills with competence in management, entrepreneurship and leadership.
3. mental and thinking skills consisting of competences in critical thinking, decision making, creativity and innovation.
4. information and communication skills.
5. Collaboration (teamwork and ethics);
6. Information literacy;

Admission and graduation requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

5. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
6. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.
2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST/ENT	Basic Science	Discipline (GET)	Programme (WRE)	SIWES*	Total Units
100	4	16	03	02	-	25
200	4	-	17	-	3	24
300	4	-	12	02	4	22
400	-	-	-	03	8	11
500	-	-	05	18	-	23
Total	**12**	**16**	**37**	**25**	**15**	**105**

*All 15 units of SIWES credited in the 2nd Semester of 400-Level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 211	Nigerian People and Culture	2	C	30	-
GET 101	Engineer in Society	1	C	15	-
GET 102	Engineering Graphics and Solid Modelling I	2	C	15	30
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	45	-
MTH 102	Elementary Mathematics II	2	C	45	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	C	-	45
WRE 101	Introduction to Water Resources Engineering	2	C	30	-
	Total	**25**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I	3	C	9 weeks	
	Total	**21**			

300Level

Course Code	Course Title	Units	Status	LH	PH
ENT 312	Venture Creation	2	C	15	45
GST 321	Peace and Conflict Resolution	2	C	30	-
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
CEE 304	Civil Engineering Materials	2	C	30	-
WRE 301	Public Health Engineering	3	E	45	-
WRE 303	Hydraulics and Hydrology I	2	E	30	-
WRE 308	Engineering Geology	2	E	30	-
*GET 399	SIWES II: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**18**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
WRE 401	Soil Mechanics and Foundation Engineering	3	C	45	-
WRE 403	Hydraulics and Hydrology II	3	E	45	-
WRE 405	Design of Hydraulic Structures	3	E	45	-
*GET 499	SIWES III	8	C	24 weeks	
	Total	**3**			

***SIWES Courses**

Course Code	Course Title	Units	Status	LH/PH
GET 299	SIWES I	3	C	9 weeks
GET 399	SIWES II	4	C	12 weeks
GET 499	SIWES III: Student Industrial Work Experience Scheme	8	C	24 weeks
	Total	**15**		

*All credited in second semester of 400 level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
WRE 501	Project	6	C	-	270
WRE 503	Design of Treatment Plants	3	C	45	-
WRE 504	Hydrogeology (Groundwater Hydrology)	3	C	45	-
WRE 505	Water and Waste Water Engineering	3	C	45	-
WRE 506	Environmental Pollution Engineering	2	E	30	-
WRE 507	Drainage and Irrigation Engineering	3	C	45	-
	Total	**23**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students should be able to:

1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;

4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents

Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Major word formation processes; the sentence in English (types: structural and functional). Grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes

At the end of this course, the students should be able to:

1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents

History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I(2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids

and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;
6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102 Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units C: LH 30)

Learning Outcomes
On completion, the students should be able to:
1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents
Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work,

potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units C: LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II (1 Unit C: PH 45)

Learning Outcomes

On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents

This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

WRE 101: Introduction to Water Resources Engineering (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the focus and scope of the Water Resources Engineering Programme;
2. recognise the domestic and industrial use of water;
3. familiarise with the concept of water exploration through boreholes; and
4. gain awareness of career opportunities for the water resources engineer in the public and private space.

Course Contents

Introduction: Definition and scope of water resources engineering. Use of water for irrigation, water supply and wastewater engineering, navigation, hydropower generation, environmental sanitation and industrial use. Introduction to surface water hydrology and groundwater hydraulics, control structures such as dams, reservoirs, e.t.c. Introduction to pollution control and abatement. Introduction to field measurement and computation in water resources engineering. Career opportunities in water resources engineering.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)

Learning Outcomes

At the end of the course, students should be able to:

1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and

8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;

2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :
1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs, etc;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents

Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 208: Strength of Materials **(3 Units C: LH 45)**

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I **(3 Units C: LH 45)**

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers;
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity. Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas.

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data

New

structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes
SIWES I should provide opportunity for the students to:
1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student’s major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes,

ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, students, through case study and practical approaches, should be able to:

1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;
6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;

5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 units C: LH 30 PH 45)

Learning Outcomes
At the end of the course, the students should be able to:
1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and
5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents
Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Content: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes
At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:

1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work;
6. fill logbooks of all experience gained in their chosen careers;
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
a. design of machine components;
b. product design and innovation;
c. part modelling and drafting in SolidWorks; and
d. technical report writing.

WRE 301: Public health Engineering (3 Units E: LH 45)

Learning Outcomes
Upon successful completion of the course, the students should be able to:
1. be aware of the importance of environmental sanitation and interventions to spread infectious diseases;
2. to design interventions in solid and hazardous waste treatment and management;
3. understand water and wastewater quality characteristics and their importance in every good public health;
4. plan and design onsite sanitation technology option in any given situation; and
5. understand the importance of natural self-purification on the water quality and environment.

Course Contents
Introduction to sanitary Engineering, Structure and growth of Micro-organisms. Sterilisation and culture techniques. Water use and water-related diseases. Physical, chemical and biological characteristics of water and wastewater, their determination and significance. Appropriate technology of water supply and treatment. Coagulation, storage, filtration,

disinfection and distribution. Onsite sanitation; design and management of different types of non-water borne sanitation systems (traditional pit latrines and improved latrines), Water borne sanitation system (vaults, cesspools, septic tanks, pour flush toilets, relevant to Nigerian situation) and wastewater treatment. Sewage. Source and Effects of pollution. Water quality standards and controls. Agents of Air pollution, Effects and control. Management and finance of PHE systems. Introduction to self-purification of surface water bodies.

WRE 303: Hydraulics and Hydrology I (3 Units E: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain in detail the concept of the hydrologic cycle and compute components of the hydrologic cycle;
2. estimate and analyse the hydrograph;
3. discuss the basics of flood routing and unsteady gradually varied flow;
4. analyse simple rapidly varied unsteady flow problems; conduct flood frequency analysis and flood routing; and
5. identify the fundamentals of groundwater occurrence and evaluate yields of aquifers.

Course Contents

Introduction: hydrologic cycle, precipitation, evaporation and transpiration. Quantitative Hydrology: hydrography, volume runoff, storage routing. Groundwater: occurrence, hydraulics, well, yield.

Open channels: hydraulics of open channel flow, culverts and bridges. Steady uniform flow. Steady gradually varied flow. Hydraulic Jump. Surge Waves. Measurement of flow in open channels.

WRE 308 Engineering Geology (3 Units E: LH 45)

Learning Outcome

At the end of this course, students should be able to;

1. demonstrate understanding of geological structures and mapping;
2. understand the properties of rocks and minerals;
3. understand time scale, fossils and their importance;
4. be familiar investigation of sites for water resources projects; and
5. perform basic engineering geology assessment and analyses.

Course Content s

Geological structures and mapping. Rocks and minerals. Stratigraphy – time scale – fossils and their importance: Special reference to Nigeria.
Introduction to geology of Nigeria: Engineering Applications – Water supply – site investigations, geophysical investigation (vertical electrical sounding), – Dams, Dykes.

CEE 304: Civil Engineering Materials (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. demonstrate the suitability for use of the following Civil Engineering materials: concrete, structural steel (and other important structural metals), timber, masonry, etc;
2. conduct tests of engineering properties of Civil Engineering materials and utilise these for quality control;

3. explain the limitations of these materials under various uses; and
4. elucidate the characterisation of some of the variability and uncertainty associated with these materials.

Course Contents
Concrete technology: types of cements, aggregates, properties. Concrete mix, design, properties and their determination. Steel Technology: production fabrication and properties; corrosion and its prevention. Tests on steel and quality control. Timber technology: types of wood, properties, defects, stress grading. Preservation and fire protection; timber products, rubber, plastics, asphalt, tar, glass, lime, bricks, Applications to buildings, roads and bridges.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.
WRE 401: Soil Mechanics and Foundation Engineering (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the principles of field and laboratory compaction and its application;
2. determine strength properties of soil for engineering applications;
3. determine compressibility and strength properties of soil for design of shallow and deep foundations;

4. identify and calculate the parameters needed for the design of foundations, including footing settlement, end bearing of piles, and earth pressure coefficients; and
5. gain the ability to use modern soil mechanics equipment and soil investigation procedures.

Course Contents
Soil structures, compaction and soil stabilisation, stability of slopes earth pressures, retaining walls. Concepts of permeability, stress distribution, shear strength and pressure in relation to foundation engineering; bearing capacity of soils; shallow and deep foundations, pile foundations; Site Investigation.

WRE 403: Hydraulics and Hydrology II (3 Units E: LH 45)

Learning Outcome
At the end of this course, the students should be able to:
1. explain deeply the theories and concepts of different types of flows;
2. discuss the principles of surface water hydrology for assessment and evaluation of floods;
3. explicate the techniques for collection, processing and analysis of hydrological data and the application of catchment hydrological modelling and aquifer modelling techniques; and
4. demonstrate knowledge of the application of the principles of continuity and momentum to pipe flow.

Course Contents
Laminar and Turbulent flows. Boundary layer separation lift and drag stream function, velocity potential and application to flow nets. Steady and Unsteady flow in closed conduits. Principles of surface water hydrology. Analysis of hydrological data. Land drainage and inland navigation problems.

WRE 405: Design of Hydraulic Structures (3 Units E: LH 45)

Learning Outcome
At the end of this course, the students should be able to:
1. explain the fundamentals of reinforced concrete design;
2. select materials for different structural problems;
3. design structural elements in reinforced concrete;
4. discuss the principles of the design of hydraulic structures to address water resources problems; and
5. design structures such as dams, spillways and gates.

Course Contents
Fundamentals of design process, material selection, building regulations and codes of practice. Design philosophy. Elastic design: limit state design. Design of structural elements in reinforced concrete. Hydraulic models: hydraulic design criteria, problems of reservoirs, river training and regulations, transition structures. Dams; weirs, spillways, gates and outlet work, stilling basins. Cofferdams, breakwaters, moldes, surge tanks. Design of open channels, conduit systems and hydraulic machinery. Design of municipal storm drains, land drainage systems and culverts and bridges. Design of (i) drainage inlets, (ii) manholes, and (iii) catch basins. Introduction to multiple purpose designs involving flood control, water supply, irrigation, recreation, drainage navigation and erosion control. Computer-aided design of structures.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Content

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

WRE 501: Project (6 Units C: PH 270)

Learning Outcomes

At the end of this course, the students should be able to:

1. acquire knowledge of technical report writing and presentation;
2. familiarise with the art of research on specific subject matter;
3. collect and evaluate information on specific subject matter;
4. analyse data and synthesize research findings; and
5. report research findings in written and verbal forms

Course Contents

Projects will depend on staff expertise and interest but should be of investigatory nature. Preferably, students should be advised to choose projects in the area of their option/elective subjects.

WRE 503: Design of Treatment Plants (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. discuss the details of the design of storm water and sewage systems;
2. explain the treatment of waste through biological and chemical processes;
3. familiarise with the treatment process of water and wastewater; and
4. draw treatment schemes such as activated sludge system, trickling filter, stabilization ponds.

Course Contents

Wastewater

Storm water sewage: rational method for design. Preliminary treatment: flow measurement, weirs, flumes, flow separation, screening, storm water settlement, grit removal, overflow rates.

Batch settlement analysis; radial and rectangular design. Secondary treatment: activated sludge process, percolating filters, oxidation ponds, biological kinetics and application in sludge treatment and disposal. Anaerobic digestion. Sludge processing, pumping and power requirements.

Water Supply

Flow diagrams for the treatment of surface and groundwater. Preliminary treatment: screening, coagulation, flocculation and sedimentation. Slow sand, rapid sand and pressure filters. Disinfection: water softening, iron and manganese removal. Chemicals for water Treatment.

WRE 504: Hydrogeology (Groundwater Hydrology) (3 Units C: LH 45)

Learning Outcomes

Upon the successful completion of the course the students should be able to:

1. describe the characteristics of groundwater flow;
2. identify and measure aquifer properties and their effects on groundwater flow;
3. Compute groundwater recharge, flow and discharge;
4. decide on appropriate qualitative and quantitative methods commonly used in physical hydrogeology; and
5. employ physical based equations that describe flow in the unsaturated zone, groundwater flow under natural conditions and around a pumping well.

Course Contents

Groundwater and Aquifers: Physical Properties of Aquifers. Darcy's Law and Hydraulic conductivity. Well Flow Systems: Measurement of hydraulic conductivity, Transmissivity, Specific yield and storage coefficient. Groundwater Exploration, well construction and pumping. Mathematical Techniques – Analytical and numerical solutions and simulation. Digital Computers – Finite Difference and Finite Element techniques in groundwater modelling. Unsaturated Flow. Surface – Subsurface water relations. Computer Aided Design in Water Resources

WRE 505: Water and Waste Water Engineering (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. recognise the processes for the treatment of both surface and groundwater;
2. develop design criteria necessary for the designs for water and wastewater treatment unit operations and processes; and
3. design water supply and distribution systems including storage and pumping systems;
4. explain the design procedure and process of wastewater collection, treatment and disposal.

Course Contents

Water and wastewater inter-relationship, water and health water-borne diseases. Elements of water chemistry. Treatment processes for surface water and for groundwater. Design fundamentals for water supply treatment and water distribution systems, including storage, pumping and piping.

Sources of wastewater, industrial and domestic wastewater surveys. Elements of wastewater, microbiology; waste -water collection, treatment and disposal and their designs. Wastewater re-use-option and alternatives. Effluent standards.

WRE 506: Environmental Pollution Engineering (2 Units E: LH 30)

Learning Outcome

At the end of the course, the students should be able to:

1. recognise the different types of environmental pollution, techniques for their monitoring and control;
2. identify and value the effect of the pollutants on the environment: atmosphere, water and soil;
3. analyse an industrial activity and identify the environmental problems;
4. explain the design of control systems for different types of pollution;
5. plan strategies to control, reduce and monitor pollution;
6. select the most appropriate technique to purify and/or control the emission of pollutants;
7. discuss the effects of solid waste on water sources; and

8. elucidate the laws and regulations governing environmental pollution.

Course Contents

Air pollution: monitoring and control, air pollutants, characteristics, sources, dispersion of pollutants in air, dispersion models, equations, design of air pollution control systems.

Water pollution: types of water pollution, point sources and non-point sources, effects of pollutants on water, control and management of water pollution. Solid waste management, classification, quantification and composition of solid waste disposal methods; environmental protection regulations.

WRE 507: Drainage and Irrigation Engineering (3 Units C: LH45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the irrigation requirements for crops/-plants for effective delivery;
2. discuss soil-water relationship in respect of irrigation;
3. elucidate the principles of design, construction, operation and maintenance of different irrigation systems; and
4. explicate the sources and quality of water appropriate for effective irrigation.

Course Contents

Land classification: crop water requirements;

Crop: irrigation requirements; farm delivery requirements; diversion requirements; soil-water relationships; movement of soil moisture; measurement of infiltration and soil Moisture. Irrigation water quality. Irrigation planning criteria. Irrigation methods; supplemental irrigation, irrigation structures. Design, construction, operation and maintenance of surface, sub-surface and sprinkler irrigation systems. Surveys and investigation – sources of water, soils and salinity. Water tables; drainage structures. Subsurface drains. Design criteria – Drain size, materials used; installation of subsurface drains; urban storm drainage. Land drainage.

Minimum Academic Standards

Equipment

Fluid Mechanics Laboratory

1. Air flow equipment
2. Subsonic wind tunnel
3. Flow visualization table
4. Metacentric height apparatus
5. Orifice and free flow apparatus
6. Reynolds number apparatus
7. Centre of pressure apparatus
8. Impact of jet apparatus
9. Flow measurement apparatus
10. Venture meter
11. Pressure gauge apparatus
12. Vortex apparatus
13. Floating body apparatus
14. Manometer

Hydraulic Laboratory

1. Reciprocating pump test rig centrifugal pump test rig
2. Kaplan, francis and pelton wheel turbine

3. 381 mm tilting flume
4. 102mm tilting flume
5. 305mm tilting flume
6. 76mm tilting flume
7. 203mm tilting flume
8. Hydraulic bench
9. Surge tank apparatus
10. 610 mm sand bed table
11. Turbine/pump test rig
12. Orifice plate apparatus
13. V-notch apparatus
14. Pipe energy loss apparatus
15. Function loss in pipes apparatus
16. Flow channel
17. Volumetric hydraulic bench

Hydrology Laboratory and Display Room

1. Sunshine recorder
2. Recording rain gauge
3. Gouge height recorder
4. Current meter
5. Engineering seismograph
6. Mini flow meter
7. Wave height generator & recorder
8. Stream flow mini current meter
9. Ester line graph recorder
10. Wind vane/anemometer
11. Thermometers
12. Barometer
13. Water level recorder
14. Rain gauge (non-recording type)

Soil Analysis Laboratory

Resistivity meter
Soil moisture and density meter

Simulation Room

At least 10 desktop computers

Special Infrastructural Requirements

1. Drilling rig complete with accessories and compressor;
2. Model dam and reservoir;
3. Meteorological station;
4. Hydrology apparatus with permeability measurement ; and
5. Large laboratory spaces for flumes and scaled models.

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each

programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.
NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel
Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff
The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel
The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff
Subject to the general standards specified by NUC;
1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Library
In addition to the university and faculty libraries, the programme must have a departmental library well-equipped with specialised books and journals in both physical collections and E-collections (E-Resources) of various types. Various field and research reports of the programme must also be available in the library for staff, students and researchers.

The library must be connected to subscribed repository of:
1. national and international institutions
2. open access sources
3. professional bodies' e-learning platforms
4. relevant international organizations

The library must also have adequate facilities for reading, lending and to include reservation unit for specialized materials

Classrooms, Laboratories, Workshops, Clinics and Offices
Sizes of Office Spaces

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves

B.Eng. Wood Products Engineering

Overview

This is the new curriculum for Wood Products Engineering students in Nigerian universities. It has an improvement over the old one because it places more emphasis on both the basic and derived products of wood. It gives more time to the study of products which are recoverable from wood residue which can lead to integral utilization of the trees from our forests which in turn will contribute to the amelioration of problems arising from the climate change. The students will have access to more areas of research and specialisation. Furthermore, the primary purpose of the programme is to prepare students for career in the wood products industry. The courses are packaged to prepare graduates for immediate employment in various aspects of wood products business management/marketing, process and product quality control, and research and development. Graduates will also have opportunities for involvement in the wider scope of the industry – from harvesting to the use of wood, fibre, and chemical products. Students are exposed to basic operations such as: roundwood processing to lumber and plywood; drying and protection of wood and fibre products; adhesives and coatings; reconstructed wood composites; paper manufacture; board products; construction and housing.

Philosophy

The programme is to give prominence to sound scientific training and provide the much required impetus for rapid technological and industrial development in wood products industry. The programmes is therefore designed to give students the required academic and practical background in areas of wood harvesting and utilization of forest trees. It also emphasises the overall use of wood for different products required by different people which include furniture, plywood, particleboard, fibre board, pulp and paper and many other products needed for day-to-day activities. The students are trained to design, fabricate and maintain the specialised machines in the wood industry.

Objectives

Students in Wood Products Engineering are trained to:

1. design and implement components, machines, equipment and engineering systems required in wood and wood products manufacture;
2. design and develop new products and production techniques for wood products;
3. install and maintain complex engineering systems for optimal performance in such a way that the wood residues generated do not constitute problems to the environment;
4. adapt and adopt exogenous technology in order to solve problems requiring engineering methods in the wood industry;
5. exercise original thought, have good professional judgment and be able to take responsibility for the execution of important tasks relating to manufacturing of wood and wood-based products;
6. improve on existing indigenous solutions to problems relating to the utilisation of wood and wood products;
7. familiarise with all the materials, components, machines, equipment, production techniques and systems in the processing of wood and wood-based products;
8. man and maintain the specific production equipment used in the processing and production of wood-based materials and products;
9. plan, manage and be responsible for quality control of the products and processes in the respective wood-based industry where they will work in the future; and
10. possess managerial skills for effective management of people, fund, materials and equipment.

Employability Skills

1. Ability to plan and establish a modern wood industry
2. Able to run an existing wood industry successfully
3. Ability to design a new wood or wood-based product
4. Able to work design machines and tools relevant in the wood industry
5. Ability to train incoming personnel in requisite engineering skills personnel wood industry

21st Century skills

Graduates of Wood Products Engineering have the abilities and competence to:

1. adapt wood production processes to information communication and other emerging digital 4IR technologies (ICT plus);
2. critically thinking/problem solving/decision making;
3. collaboration (teamwork and ethics);
4. citizenship (local and global);
5. use important software for the design of new wood products;
6. information literacy; and
7. learning to learn/metacognition.

Unique Features of the Programmme

It combines Mechanical Engineering concepts and entrepreneurial zeal with the innovative and creative use of wood as raw material. The new programme is student centred and makes them adatable to the world of work and professional practice.

Admission and Graduation Requirements

Admission Requirements

Candidates are admitted into the degree programme in either of the following two ways:

1. Unified Tertiary Matriculation Examination (UTME) Mode (5 Year Degree Programme)
2. Direct Entry (DE) Mode (4 Year Degree Programme)

Unified Tertiary Matriculation Examination (UTME) Mode

For the five-year degree propgramme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination (UTME), the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five subjects, which must include English Language, Mathematics, Physics, Chemistry and other acceptable science subjects at not more than two sittings.

Direct Entry (DE) Mode

For the four-year Direct Entry, in addition to five (5) Senior School Certificate (SSC) credit passes, which must include English Language, two must be principal subjects at Advance GCE Level or NCE and its equivalent. Holder of upper credit level at HND are eligible for consideration for admission into 300 level.

Graduation Requirements

The following regulations shall govern the conditions for the award of a honours degree in Engineering and Technology:

1. Candidates admitted through the UTME mode shall have registered for a minimum of 150 and maximum of 180 units of courses during the 5–year engineering degree programme. Such candidates shall have spent a minimum of ten academic semesters.

2. Candidates admitted through the Direct entry mode shall have registered for minimum of 120 and maximum of 150 units of courses during a 4–year engineering degree programme. Such candidates shall have spent a minimum of eight academic semesters
3. The minimum and maximum credit load per semester is 15 and 24 credit units respectively.
4. A student shall have completed and passed all the Courses registered for, including all compulsory courses and such elective /optional courses as may be specified by the university/faculty or department; obtained a minimum Cumulative Grade Point Average (CGPA) specified by the university but not less than 1.00.
5. A student shall also have earned the 15 credit units of Students Industrial Work Experience Scheme (SIWES), 8 credit units of University General Study courses and four credit units of Entrepreneurship courses.

For the purpose of calculating a student's cumulative grade point average (CGPA) in order to determine the class of Degree to be awarded, grades obtained in ALL the courses registered, whether compulsory or optional and whether passed or failed must be included in the computation. Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA.

Prerequisite courses must be taken and passed before a particular course at a higher level. Furthermore, if a student fails to graduate at the end of normal academic session, he or she would not be allowed to exceed a total of 15 semesters in the case of students admitted through UTME and 13 semesters in the case of Direct Entry students.

Global Course Structure

Level	GST	ENT	Basic Sciences	GET	Programme (WPE)	SIWES	Total Units
100	4	-	19	3	2	-	**28**
200	4	2	-	21	-	3	**30**
300	-	2	-	11	6	4	**23**
400	-	-	-	-	5	8	**13**
500	-	-	-	5	6	-	**11**
Total	**8**	**4**	**19**	**40**	**19**	**15***	**105**

* All 15 units of SIWES credited in the 2nd Semeter of 400-level

100 Level

Course Code	Course Title	Units	Status	LH	PH
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	
GET 101	Engineer in Society	1	C	30	-
GET 102	Engineering Graphics and Solid Modelling	2	C	15	30
CHM 101	General Chemistry I	2	C	30	-
CHM 102	General Chemistry II	2	C	30	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	C	-	45
MTH 101	Elementary Mathematics I	2	C	30	-
MTH 102	Elementary Mathematics II	2	C	30	-
PHY 101	General Physics I	2	C	30	-
PHY 102	General Physics II	2	C	30	-
PHY 107	General Practical Physics I	2	C	-	45
BIO 101	General Biology I	3	C	15	30
WPE 102	Introduction to Wood Products Engineering	2	C	30	
	Total	**28**			

200 Level

Course Code	Course Title	Units	Status	LH	PH
GST 212	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Engineering Materials	3	C	45	-
GET 204	Students Workshop Practice	2	C	15	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 207	Applied Mechanics	3	E	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	C	45	-
GET 210	Engineering Mathematics II	3	C	45	-
GET 211	Computing and Software Engineering	3	C	30	45
*GET 299	SIWES I: Students Work Experience Scheme	3	C	9 Weeks	
	Total	**27**			

300 Level

Course Code	Course Title	Units	Status	LH	PH
GST 312	Peace and Conflict Resolution	2	C	30	
ENT 312	Venture Creation	2	C	15	45
GET 304	Technical Writing and Communication	3	C	45	-
GET 305	Engineering Statistics and Data Analytics.	3	C	45	-
GET 306	Renewable Energy Systems and Technologies	3	C	30	45
GET 307	Introduction Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	
WPE 305	Silviculture	2	C	15	45
WPE 306	Basic Properties of Wood	2	E	15	45
WPE 307	Wood Harvesting	2	E	15	45
WPE 311	Wood Workshop Practice	1	C	-	45
*GET 399	SIWES III: Students Work Experience Scheme	4	C	12 Weeks	
	Total	**19**			

400 Level

Course Code	Course Title	Units	Status	LH	PH
WPE 401	Engineering Properties of Wood	2	C	15	45
WPE 403	Wood Physics	2	E	15	45
WPE 405	Wood Deterioration and Preservation	2	E	15	45
WPE 407	Wood-Based Panel Products I (Veneer and Plywood)	3	C	30	45
WPE 409	Sawmilling	2	E	15	45
WPE 411	Furniture Design and Production	2	E	15	45
*GET 499	SIWES III: Students Work Experience Scheme	8	C	24 Weeks	
	Total	**5**			

SIWES CourSIWES courses*

Course Code	Course Title	Units	Status	LH	PH
GET 299	SIWES I	3	C	9 weeks	
GET 399	SIWES II	4	C	12 weeks	
GET 499	SIWES III	8	C	24weeks	
	Total	**15***			

* All credited in the 2nd Semester of 400-Level

500 Level

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Project Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
WPE 511	Final year Project	6	C	-	270
	Total	**11**			

Course Contents and Learning Outcomes

100 Level

GST 111: Communication in English (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students should be able to:
1. identify possible sound patterns in English Language;
2. list notable language skills;
3. classify word formation processes;
4. construct simple and fairly complex sentences in English;
5. apply logical and critical reasoning skills for meaningful presentations;
6. demonstrate an appreciable level of the art of public speaking and listening; and
7. write simple and technical reports.

Course Contents
Sounds and sound patterns in English Language (vowels and consonants, phonetics and phonology). English word classes (lexical and grammatical words, definitions, forms, functions, usages, collocations). Major word formation processes; the sentence in English (types: structural and functional). Grammar and usage (tense, concord and modality). Reading and types of reading, comprehension skills, 3RsQ. Logical and critical thinking; reasoning methods (logic and syllogism, inductive and deductive argument, analogy, generalisation and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writin (brainstorming and outlining). Writing (paragraphing, punctuation and expression). post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making, etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)

Learning Outcomes
At the end of this course, students should be able to:
1. analyse the historical foundation of Nigerian cultures and arts in pre-colonial times;
2. identify and list the major linguistic groups in Nigeria;
3. explain the gradual evolution of Nigeria as a political entity;
4. analyse the concepts of trade and economic self-reliance of Nigerian peoples in relation to national development;
5. enumerate the challenges of the Nigerian state regarding nation building;
6. analyse the role of the judiciary in upholding fundamental human rights
7. identify the acceptable norms and values of the major ethnic groups in Nigeria; and
8. list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline (WAI), War Against Indiscipline and Corruption(WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

GET 101: Engineer in Society (1 Unit C: LH 15)

Learning Outcomes
At the end of this course, the students should be able to:
1. differentiate between science, engineering and technology, and relate them to innovation;
2. distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies;
3. identify and distinguish between the relevant professional bodies in engineering;
4. categorise the goals of global development or sustainable development goals (SDGs); and
5. identify and evaluate safety and risk in engineering practice.

Course Contents
History, evolution and philosophy of science. engineering and technology. The engineering profession – engineering family (engineers, technologists, technicians and craftsmen), professional bodies and societies. Engineers' code of conduct and ethics, and engineering literacy. Sustainable development goals (SDGs), innovation, infrastructures and nation building - economy, politics, business. Safety and risk analysis in engineering practice. Engineering competency skills – curriculum overview, technical, soft and digital skills. Guest seminars and invited lectures from different engineering professional associations.

GET 102: Engineering Graphics and Solid Modelling I(2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple everyday and also complex problems;
2. recognise the fundamental concepts of engineering drawing and graphics;
3. show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;

4. analyse such models for strength and cost;
5. prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6. recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7. analyse and master the basics of mechanical and thermal loads in engineering systems.

Course Contents

Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation workspaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

CHM 101: General Chemistry I (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:
1. define atom, molecules and chemical reactions;
2. discuss the modern electronic theory of atoms;
3. write electronic configurations of elements on the periodic table;
4. rationalise the trends of atomic radii, ionisation energies, electronegativity of the elements, based on their position in the periodic table;
5. identify and balance oxidation–reduction equation and solve redox titration problems;
6. draw shapes of simple molecules and hybridised orbitals;
7. identify the characteristics of acids, bases and salts, and solve problems based on their quantitative relationship;
8. apply the principles of equilibrium to aqueous systems using LeChatelier's principle to predict the effect of concentration, pressure and temperature changes on equilibrium mixtures;
9. analyse and perform calculations with the thermodynamic functions, enthalpy, entropy and free energy; and
10. determine rates of reactions and its dependence on concentration, time and temperature.

Course Contents

Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence forces; Structure of solids. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II **(2 Units C: LH 30)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the importance and development of organic chemistry;
2. define fullerenes and its applications;
3. discuss electronic theory;
4. determine the qualitative and quantitative of structures in organic chemistry;
5. state rules guiding nomenclature and functional group classes of organic chemistry;
6. determine the rate of reaction to predict mechanisms of reaction;
7. identify classes of organic functional group with brief description of their chemistry;
8. discuss comparative chemistry of group 1A, IIA and IVA elements; and
9. describe basic properties of transition metals.

Course Contents
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nanotubules, nanostructures, nanochemistry. Electronic theory in organic chemistry. Isolation and purification of organic compounds; determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry; nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correct carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. state the differences between primary and secondary standards;
5. perform redox titration;
6. record observations and measurements in the laboratory notebooks; and
7. analyse the data to arrive at scientific conclusions.

Course Contents
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Practical Chemistry II **(1 Unit C: PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. state the general laboratory rules and safety procedures;
2. collect scientific data and correctly carry out chemical experiments;
3. identify the basic glassware and equipment in the laboratory;
4. identify and carry out preliminary tests which include ignition, boiling point, melting point, test on known and unknown organic compounds;
5. carry out solubility tests on known and unknown organic compounds;

6. carry out elemental tests on known and unknown compounds; and
7. carry out functional group/confirmatory test on known and unknown compounds which could be acidic/basic/ neutral organic compounds.

Course Contents
Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)

Learning Outcomes
At the end of the course students should be able to:
1. define and explain set, subset, union, intersection, complements, and demonstrate the use of Venn diagrams;
2. solve quadratic equations;
3. solve trigonometric functions;
4. identify various types of numbers; and
5. solve some problems using binomial theorem.

Course Contents
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real numbers, integers, rational and irrational numbers. Mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers, the argand diagram. De-Moiré's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

MTH 102: Elementary Mathematics II (Calculus) (2 Units C: LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. identify the types of rules in differentiation and integration;
2. recognise and understand the meaning of function of a real variable, graphs, limits and continuity;
3. solve some applications of definite integrals in areas and volumes;
4. solve function of a real variable, plot relevant graphs, identify limits and idea of continuity;
5. identify the derivative as limit of rate of change;
6. identify techniques of differentiation and perform extreme curve sketching;
7. identify integration as an inverse of differentiation;
8. identify methods of integration and definite integrals; and
9. perform integration application to areas, volumes.

Course Contents
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101: General Physics I (Mechanics) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. identify and deduce the physical quantities and their units;
2. differentiate between vectors and scalars;
3. describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4. apply Newton's laws to describe and solve simple problems of motion;
5. evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6. explain and apply the principles of conservation of energy, linear and angular momentum;
7. describe the laws governing motion under gravity; and
8. explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

Space and time; units and dimension, vectors and scalars, differentiation of vectors: displacement, velocity and acceleration; kinematics; Newton's laws of motion (inertial frames, impulse, force and action at a distance, momentum conservation); relative motion; application of Newtonian mechanics; equations of motion; conservation principles in physics, conservative forces, conservation of linear momentum, kinetic energy and work, potential energy, system of particles, centre of mass; rotational motion; torque, vector product, moment, rotation of coordinate axes and angular momentum. Polar coordinates; conservation of angular momentum; circular motion; moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

PHY 102: General Physics II (Behaviour of Matter) (2 Units: C, LH 30)

Learning Outcomes

On completion, the students should be able to:

1. explain the concepts of heat and temperature and relate the temperature scales;
2. define, derive and apply the fundamental thermodynamic relations to thermal systems;
3. describe and explain the first and second laws of thermodynamics, and the concept of entropy;
4. state the assumptions of the kinetic theory and apply techniques of describing macroscopic behaviour;
5. deduce the formalism of thermodynamics and apply it to simple systems in thermal equilibrium; and
6. describe and determine the effect of forces and deformation of materials and surfaces.

Course Contents

Heat and temperature, temperature scales; gas laws; general gas equation; thermal conductivity; first Law of thermodynamics; heat, work and internal energy, reversibility; thermodynamic processes; adiabatic, isothermal, isobaric; second law of thermodynamics; heat engines and entropy, Zero's law of thermodynamics; kinetic theory of gases; molecular collisions and mean free path; elasticity; Hooke's law, Young's shear and bulk moduli; hydrostatics; pressure, buoyancy, Archimedes' principles; Bernoullis equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 107: General Practical Physics I **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs; and
5. draw conclusions from numerical and graphical analysis of data.

Course Contents
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY 101, 102, 103 and PHY 104). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

PHY 108: General Practical Physics II **(1 Unit C: PH 45)**

Learning Outcomes
On completion, the student should be able to:

1. conduct measurements of some physical quantities;
2. make observations of events, collect and tabulate data;
3. identify and evaluate some common experimental errors;
4. plot and analyse graphs;
5. draw conclusions from numerical and graphical analysis of data; and
6. prepare and present practical reports.

Course Contents
This practical course is a continuation of PHY 107 and is intended to be taught during the second semester of the 100 level to cover the practical aspect of the theoretical courses that have been covered with emphasis on quantitative measurements, the treatment of measurement errors, and graphical analysis. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

BIO 101: General Biology **(3 Units: C, LH 45)**

Learning Outcomes
Students should be able to:

1. explain the characteristics of living and non-living things;
2. outline the taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates;
3. describe the scientific methods to biology concepts;
4. explain the cell concepts, structure, organisation, functions, and chemical and physical characteristics; and
5. state the elements of biological chemistry, and of ecology and types of herb.

Course Contents
Characteristics of living and non-living things. Scientific methods to biology concepts. Taxonomy of living organisms – microbes, plants including field and herbarium methods, animals including vertebrates and invertebrates. Morphology and life cycles of phyla and plant kingdoms. Cell concepts, structure, organization, functions, and chemical and physical characteristics. Cells, tissues and organ systems, and organisms. Elements of biological chemistry – cellular metabolism - aspects of organic, inorganic and physical chemistry relevant to biology. Elements of ecology and types of habitats

WPE 102: Introduction to Wood Products Engineering (2 Units, C: LH 30)

Learning outcomes
At the end of this course, the students should be able to:
1. discuss the importance of wood products engineering as a profession;
2. explain of available opportunities to a graduate of wood products engineering; and
3. develop interest in the course.

Course Contents
Wood as a forest resource in Nigeria and at the world level. The need for wood products in our society. Wood Products Engineering as a means to satisfy need. Contributions of Wood Products Engineering to national economy and industrial development. Scientific research in the wood industry. Overview of different wood industries in Nigeria. Available opportunities to graduates of Wood Products Engineering.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units: C, LH 30)

Learning Outcomes
At the end of the course, students should be able to:
1. know the basic features of philosophy as an academic discipline;
2. identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3. know the elementary rules of reasoning;
4. distinguish between valid and invalid arguments;
5. think critically and assess arguments in texts, conversations and day-to-day discussions;
6. critically asses the rationality or otherwise of human conduct under different existential conditions;
7. develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8. guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding.

ENT 211: Entrepreneurship and Innovation (2 Units: C, LH 30)

Learning Outcomes

At the end of this course, students should be able to:

1. explain the concepts and theories of entrepreneurship, intrapreneurship, opportunity seeking, new value creation and risk-taking;
2. state the characteristics of an entrepreneur;
3. analyse the importance of micro and small businesses in wealth creation, employment generation and financial independence;
4. engage in entrepreneurial thinking;
5. identify key elements in innovation;
6. describe the stages in enterprise formation, partnership and networking, including business planning;
7. describe contemporary entrepreneurial issues in Nigeria, Africa and the rest of the world; and
8. state the basic principles of e-commerce.

Course Contents

The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GET 201: Applied Electricity I (3 Units, C, LH 30, PH 45)

Learning Outcomes

Students will be able to:

1. discuss the fundamental concepts of electricity and electrical d.c. circuits;
2. state, explain and apply the basic d.c. circuit theorems;
3. explain the basic a.c. circuit theory and
4. apply to solution of simple circuits.

Course contents

Fundamental concepts: Electric fields, charges, magnetic fields. current, B-H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance, susceptance.

GET 202: Engineering Materials **(3 Units: C, LH 45)**

Learning Outcomes

At the end of this course, the students should be able to :

1. demonstrate the role of atoms and molecules (aggregates of atoms) in the building of solid/condensed matter known as engineering materials, the electrons quantum numbers and how the electrons are arranged in different atomic elements, and explain the role of electronic configuration and valence electrons in bonding;
2. define metals, alloys and metalloids, demonstrate mental picture of the solid mineral resources development as a relay race among four 'athletes': geologist, mining engineer, mineral processing technologist, process metallurgical engineer, and classify metallurgical engineering into 3Ps: process, physical and production;
3. explain the relationship between structure and properties of materials, characteristics, components and compositions of phase diagrams and phase transformations of solid solutions;
4. define ceramics, glass and constituents of glasses and understand application of ceramics in mining, building, art and craft industries;
5. define and classify polymers as a class of engineering materials and polymeric materials, demonstrate polymerisation reactions, their types and mechanism, and applications of polymers;
6. define properties, types and application of composite materials and fibres (synthetic and natural);
7. define and classify nanomaterials, demonstrate applications of nanomaterials, concept, design and classification of fracture mechanics, corrosion classification, including the five principal ways of controlling corrosion and metal finishing processes such as sherardising, galvanising and anodising; and
8. identify factors affecting the performance and service life of engineering materials/metals and metallography of metals/materials (materials anatomy), which enables metallurgical and materials engineers to prescribe appropriate solutions to test metals/materials fitness in service through structure-property-application relationships.

Course Contents

Basic material science; atomic structure, atomic bonding and crystal structures. Engineering materials situating metals and alloys; metals and alloys, classifications of metals, metal extraction processes using iron and steel (ferrous) and aluminium (nonferrous) as examples, phase diagrams/iron carbon diagrams, and mechanical workings of metals. Selection and applications of metals and alloys for specific applications in oil, aerospace, construction, manufacturing and transportation industries, among others. Ceramics (including glass); definition, properties, structure and classifications of ceramics. Bioactive and glass – ceramics. Toughing mechanism for ceramics. Polymers; definition of polymers as engineering materials, chemistry of polymeric materials, polymer crystallisation, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterisation, properties and composite. Applications of composites. Nanomaterials; definition, classification and applications of nanomaterials as emerging technology. Processing of nanomaterials including mechanical grinding, wet chemical synthesis, gas phase synthesis, sputtered plasma processing, microwave plasma processing and laser ablation. Integrity assessment of engineering materials; effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Metallography and fractography of materials. Mechanical testing (destructive testing) of materials such as compressive test, tensile test, hardness test,

impact test, endurance limit and fatigue test. Non-destructive test (NDT) such as dye penetrant, x-ray and eddy current.

GET 204: Students Workshop Practice (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. identify various basic hands and machine tools, analogue and digital measurement devices and instruments, and acquire skills in their effective use and maintenance;
2. practically apply basic engineering technologies, including metrology, casting, metal forming and joining, materials removal, machine tooling (classification, cutting tool action, cutting forces, non-cutting production) and CNC machining technology;
3. master workshop and industrial safety practices, accident prevention and ergonomics;
4. physically recognise different electrical & electronic components like resistances, inductances, capacitances, diodes, transistors and their ratings;
5. connect electric circuits, understand different wiring schemes, and check ratings of common household electrical appliances and their basic maintenance; and
6. determine household and industrial energy consumption, and understand practical energy conservation measures.

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice.Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press-tool work, spinning, etc.). Metal joining processes(welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines.
Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

GET 205: Fundamentals of Fluid Mechanics (3 Units C: LH 45)

Learning Outcomes

At the end of this course, the students should be able to :

1. explain the properties of fluids;
2. determine forces in static fluids and fluids in motion;
3. determine whether a floating body will be stable;
4. determine the effect of various instruments, (valves, orifices, bends and elbows) on fluid flow in pipes;
5. measure flow parameters with venturi meters, orifice meters, weirs;
6. perform calculations based on principles of mass, momentum and energy conservation;
7. perform dimensional analysis and simple fluid modelling problems; and
8. specify the type and capacity of pumps and turbines for engineering applications

Course Contents
Fluid properties, hydrostatics, fluid dynamics using principles of mass, momentum and energy conservation from a control volume approach. Flow measurements in pipes, dimensional analysis, and similitude, 2-dimensional flows. Hydropower systems.

GET 207: Applied Mechanics (3 Units E: LH 45)

Learning Outcomes
Students will acquire the ability to:
1. explain the fundamental principles of applied mechanics, particularly equilibrium analysis, friction, kinematics and momentum;
2. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
3. synthesize Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
4. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Contents
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyse

GET 208: Strength of Materials (3 Units C: LH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. recognise a structural system that is stable and in equilibrium;
2. determine the stress-strain relation for single and composite members based on Hooke's law;
3. estimate the stresses and strains in single and composite members due to temperature changes;
4. evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads;
5. determine bending stresses and their use in identifying slopes and deflections in beams;
6. use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains;
7. evaluate the stresses and strains due to torsion on circular members; and
8. determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents
Consideration of equilibrium; composite members, stress-strain relation. Generalised Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr’s circle. Elastic buckling of columns.

GET 209: Engineering Mathematics I (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. solve qualitative problems based on vector and matrix analyses such as linear independence and dependence of vectors, rank etc;
2. describe the concepts of limit theory and nth order differential equations and their applications to physical phenomena;
3. solve the problems of differentiation of functions of two variables and know about the maximization and minimization of functions of several variables;
4. describe the applications of double and triple integration in finding the area and volume of engineering solids, and explain the qualitative applications of Gauss, Stoke's and Green's theorem;
5. explain ordinary differential equations and applications, and develop a mathematical model of linear differential equations, as well as appreciate the necessary and sufficient conditions for total differential equations; and
6. analyse basic engineering models through partial differential equations such as wave equation, heat conduction equation, etc., as well as fourier series, initial conditions and its applications to different engineering processes.

Course Contents

Limits, continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, vector algebra, vector calculus, directional derivatives.

GET 210: Engineering Mathematics II (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe physical systems using ordinary differential equations (ODEs);
2. explain the practical importance of solving ODEs, solution methods, and analytically solve a wide range of ODEs, including linear constant coefficient types;
3. numerically solve differential equations using MATLAB and other emerging applications;
4. perform calculus operations on vector-valued functions, including derivatives, integrals, curvature, displacement, velocity, acceleration, and torsion, as well as on functions of several variables, including directional derivatives and multiple integrals;
5. solve problems using the fundamental theorem of line integrals, Green's theorem, the divergence theorem, and Stokes' theorem, and perform operations with complex numbers; and
6. apply the concept and consequences of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions of complex variables, as well as the theory of conformal mapping to solve problems from various fields of engineering; and
7. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula.

Course Contents

Introduction to ordinary differential equations (ODEs); theory, applications, methods of solution; second order differential equations. Advanced topics in calculus (vectors and vector-valued function, line integral, multiple integral and their applications). Elementary complex analysis including functions of complex variables, limits and continuity.

Derivatives, differentiation rules and differentiation of integrals. Cauchy-Riemann equation, harmonic functions, basic theory of conformal mapping, transformation and mapping and its applications to engineering problems. Special functions.

GET 211: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. describe and apply computing, software engineering knowledge, best practices, and standards appropriate for complex engineering software systems;
2. develop competence in designing, evaluating, and adapting software processes and software development tools to meet the needs of an advanced development project through practical object-oriented programming exposure taught in concrete terms with a specific modern language – preferable selected from Python, Java or C++;
3. use widely available libraries to prepare them for machine learning, graphics and design simulations;
4. develop skills in eliciting user needs and designing an effective software solution;
5. recognise human, security, social, and entrepreneurial issues and responsibilities relevant to engineering software and the digitalisation of services; and
6. acquire capabilities that can further be developed to make them productively employable by means of short Internet courses in specific areas;

Course Contents

Introduction to computers and computing; computer organisation – data processing, memory, registers and addressing schemes; Boolean algebra; floating-point arithmetic; representation of non-numeric information; problem-solving and algorithm development; coding (solution design using flowcharts and pseudo codes). Data models and data structures; computer software and operating system; computer operators and operators precedence; components of computer programs; introduction to object oriented, structured and visual programming; use of MATLAB in engineering applications. ICT fundamentals, Internet of Things (IoT). Elements of software engineering.

GET 299: Students Industrial Work Experience I (3 Units C: 9 weeks)

Learning Outcomes

SIWES I should provide opportunity for the students to:

1. acquire industrial workplace perceptions, ethics, health and safety consciousness, inter-personal skills and technical capabilities needed to give them a sound engineering foundation;
2. learn and practise basic engineering techniques and processes applicable to their specialisations;
3. build machines, devices, structures or facilities relevant to their specific engineering programmes and applications; and
4. acquire competence in technical documentation (log-book) and presentation (report) of their practical experiences.

Course Contents

Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry

equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

NOTE: **Each programme to indicate additional details of programme-specific activities for their students.**

300 Level

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)

Learning Outcomes
At the end of this Course, students should be able to:
1. analyse the concepts of peace, conflict and security;
2. list major forms, types and root causes of conflict and violence;
3. differentiate between conflict and terrorism;
4. enumerate security and peace building strategies; and
5. describe the roles of international organisations, media and traditional institutions in peace building.

Course Contents
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders, etc.). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs);the role of NGOs in post-conflict situations/crises.

ENT 312 : Venture Creation (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, students, through case study and practical approaches, should be able to:
1. describe the key steps in venture creation;
2. spot opportunities in problems and in high potential sectors, regardless of geographical location;
3. state how original products, ideas and concepts are developed;
4. develop a business concept for further incubation or pitching for funding;
5. identify key sources of entrepreneurial finance;

6. implement the requirements for establishing and managing micro and small enterprises;
7. conduct entrepreneurial marketing and e-commerce;
8. apply a wide variety of emerging technological solutions to entrepreneurship; and
9. appreciate why ventures fail due to lack of planning and poor implementation.

Course Contents

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 304: Technical Writing and Communication (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the student should be able to:

1. demonstrate the concept of clear writing, common pitfalls and unambiguous language in engineering communication, including technical reporting for different applications and emotional comportment;
2. demonstrate the skills of language flexibility, formatting, logic, data presentation styles, referencing, use of available aids, intellectual property rights, their protection, and problems in engineering communication and presentation; and
3. demonstrate good interpersonal communication skills through hands-on and constant practice on real-life communication issues for engineers in different sociocultural milieu for engineering designs, structural failure scenarios and presentation of reports.

Course Contents

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 305: Engineering Statistics and Data Analytics (3 Units C: LH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. work with data from the point of view of knowledge convergence, machine learning, and intelligence augmentation, which significantly raises their standard for engineering analysis (the approach forces them to learn statistics in an actionable way that helps them to see the holistic importance of data analytics in modern engineering and technology);
2. anticipate the future with Artificial Intelligence while fulfilling the basic requirements of conventional engineering statistical programming consistent with their future careers;
3. perform, with proficiency, statistical inference tasks with language or programming toolboxes such as R, Python, Mathematica or MATLAB, and Design Expert to summarise analysis and interpretation of industry engineering data, and make appropriate conclusions based on such experimental and/or real-life industrial data;
4. construct appropriate graphical displays of data and highlight the roles of such displays in data analysis, particularly the use of statistical software packages;
5. plan and execute experimental programmes to determine the performance of programme-relevant industrial engineering systems, and evaluate the accuracy of the measurements undertaken; and
6. demonstrate mastery of data analytics and statistical concepts by communicating the results of experimental and industry-case investigations, critically reasoned scientific and professional analysis through written and oral presentation.

Course Contents

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

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GET 306: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

Learning Outcomes

At the end of the course, the students should be able to:

1. identify the types, uses and advantages of renewable energy in relation to climate change;
2. design for use the various renewable energy systems;
3. recognise and analyse the current energy systems in Nigeria, their impacts on development and the global energy demand and supply scenarios;
4. appreciate the environmental impact of energy exploitation and utilisation, and pursue the sustainable development of renewable energy for various applications; and

5. recognise the exploitation, excavation, production, and processing of fossil fuels such as coal, petroleum and natural gas, and discuss the sources, technology and contribution to future energy demands of renewable energy.

Course Contents

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.

Practical Contents

Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; transesterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 307: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

Learning Outcomes

At the completion of the course, the students are expected to be able:

1. explain the meaning, purpose, scope, stages, applications and effects of artificial intelligence;
2. explain the fundamental concepts of machine learning, deep learning and convergent technologies;
3. demonstrate the difference between supervised, semi-supervised and unsupervised learning;
4. demonstrate proficiency in machine learning workflow and how to implement the steps effectively;
5. explain natural languages, knowledge representation, expert systems and pattern recognition;
6. describe distributed systems, data and information security and intelligent web technologies;
7. explain the concept of big data analytics, purpose of studying it, issues that can arise with a data set and the importance of properly preparing data prior to a machine learning exercise; and
8. explain the concepts, characteristics, models and benefits, key security and compliance challenges of cloud computing.

Course Contents

Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 399: Students Industrial Work Experience II (4 Units C: 12 weeks)

Learning Outcomes
At the end of the SIWES, students should be able to:
1. demonstrate proficiency in at least any three softwares in their chosen career choices;
2. demonstrate proficiency in some animation videos (some of which are free on YouTube) in their chosen careers;
3. carry out outdoor hands-on construction activities to sharpen their skills in their chosen careers;,
4. demonstrate proficiency in generating data from laboratory analysis and develop empirical models;
5. demonstrate proficiency in how to write engineering reports from lab work ;
6. fill logbooks of all experience gained in their chosen careers; and
7. write a general report at the end of the training.

The experience is to be graded and the students must pass all the modules of the attachment and shall form part of CGPA.

Course Contents
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, andwooden furniture making processes.

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.

A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:
1. design of machine components;
2. product design and innovation;
3. part modelling and drafting in SolidWorks; and
4. technical report writing.

WPE 305: Silviculture (2 Units C: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the purpose of silviculture and relate it to availability of wood resources in the wood industry;
2. discuss ways of raising tree crops and understanding the problems inherent in raising trees; and
3. elucidate how to process and store seeds, raise tree seedlings and show understanding of the underlying principles in the choice of tree species for plantation establishment.

Course Contents
Types of forests including their differences. Plantation establishment including types of nursery and mechanisation of nursery and plantation practices. Site preparation methods such as the use of manual, chemicals, fire and mechanised methods including their advantages and disadvantages. Processes relating to planting of trees and tending operations including beating-up, thinning, pruning, weeding, etc.

WPE 306: Basic Properties of Wood (2 Units E: LH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. describe how wood is formed, know the principal cell types and their function in wood;
2. relate the anatomy and cell wall structure of wood to its physical and mechanical properties;
3. identify some major commercial timber species in Nigeria; and
4. discuss wood and moisture relationship, problems and measures to control its effect in wood utilisation.

Course Contents
Structure of woods and its influence on wood properties; gross characteristics of wood; macro and microscopic features of hardwoods. Wood and water interactions. General consideration of physical and mechanical properties of wood. Identifications of Nigeria wood at the macroscopic level.

WPE 307: Wood Harvesting and Transport (2 Units E: LH 15; PH 45)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the legal requirements for tree felling;
2. discuss the methods of harvesting trees, the tools and equipment for harvesting and the various of system of transportation from the point of harvesting of trees until the harvested timber reaches the desired destination;
3. prepare guidelines for tree harvesting from the forest; and
4. maintain schedule for power chain saw, which is a major equipment for harvesting wood from trees.

Course Contents
Methods of harvesting. Terrain and its effects on harvesting. Equipment for harvesting. Age and maturity determination in forest trees. Wood transportation systems. Equipment for transportation.

WPE 311: Wood Workshop Practice (2 Units C: LH /PH 30)

Learning Outcomes
At the end of this course, the students should be able to:
1. explain the safety guidelines for smooth workshop operations and particularly those related to individual equipment in the workshop;
2. discuss how to use different wood processing equipment such as band saw, universal planning machine, circular saws, spindle moulder, etc.; and
3. elucidate the scheduled maintenance practices for the wood processing equipment.

Course Contents
Different practical works in the wood workshop will include the use of simple tools in wood work such as cramps and shooting boards; cutting tools including saws, chisels and planes; other fixing tools such as nail punches, mallets, hammers, screw drivers and the rachet brace. Ideal layout of a wood workshop; wood conversion methods such as slabbing, quarter sawing and tangential sawing. Identification of types and sizes/dimensions of timber in the market. Construction of different wood joints including widening joints, tongue and grove, mitre, tee and cross-halving joints, dowel, etc.

400 Level

GET 499: Students Industrial Work Experience III (8 Units C: 24 weeks)

Learning Outcomes
Students on Industrial Work Experience Scheme (SIWES) are expected to:
1. be exposed and prepared for the Industrial work situation they are likely to meet after graduation, by developing their occupational competencies;
2. bridge the existing gap between theory and practice of programmes through exposure to real-life situations, including machines and equipment handling, professional work methods and ethics, human relations, key performance assessment methods, and ways of safeguarding the work environment – human and materials;
3. experience/simulate the transition phase of students from school to the world of work and the environment seamlessly,and expose them to contacts for eventual job placements after graduation;
4. be motivated to identify the industrial and practice engineering challenges of their place of engagement and the larger society and creatively device impactful solutions to them; and
5. exploit the opportunity to improve and utilise their acquired critical thinking and innate creativity skills, during the program and SIWES Seminar presentation respectively.

Course Contents
On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6

months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 299, GET 399 and GET 499), on which a seminar will be presented to the Department for overall assessment.

WPE 401: Engineering Properties of Wood (2 Units C: LH 15; PH 45)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the relationship between anisotropy and orthotropic behaviour of wood;
2. discuss how the various cellular components of wood and their structure influences the mechanical behaviour of wood;
3. explicate how wood is graded either for structural use or non-structural applications; and
4. elucidate ways of determining the mechanical and visco-elastic properties of wood.

Course Contents

Orthotropic nature of wood, structural models of wood, standard tests and stress calculations, creep and relaxation. Non-destructive testing. Effect of density, moisture content and temperature on strength; natural defects in wood and their effects on its properties; wood deterioration and casual; grading rules.

WPE 403: Wood Physics (2 Units C: LH 30)

Learning Outcomes

At the end of this course, the students should be able to:

1. explain the meaning of anisotropy and how anisotropic nature of wood affects properties such as transmission of heat, sounds, electricity etc. in different directions of wood, i.e., in the longitudinal, radial and tangential.

Course Contents

Wood anisotropy, elasticity and rheology. Wood fracture; wood mass; heat and charge transport; electrical and acoustic properties, thermodynamics, wood-fluid interactions.

WPE 405: Wood Deterioration and Preservation (2 Units E: LH 15; PH 45)

Learning outcomes

At the end of this course, the students should be able to:

1. discuss the basic requirements for wood deterioration either by fungi, insects including marine borers;
2. explain how to differentiate how abiotic agents leads to wood degradation; and
3. elucidate the treatment methods and chemicals for preventing wood deterioration and the environmental guidelines and restrictions that apply.

Course Contents

Deterioration of wood by fungi, insects, and marine borers. Types of decay organisms, decay, condition mechanisms, and consequences. Other agents of wood degradation; fire weathering, discolourations. Wood protection against deterioration; chemical used for wood preservation and techniques applied in wood preservation.

WPE 407: Wood-Based Panel Products I (Veneer and Plywood) **(3 Units C: LH 30; PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss how to select raw materials for production of these products and the processes involved in their production; and
2. elucidate the methods used in testing and grading the products to various end-users.

Course Contents
Classification and properties of wood for veneer. Preparation of wood for veneer. Veneer cutting methods. Drying and storage. Uses of veneer. Preparation of veneer for plywood. Plywood production: sorting, glue addition, pressing, acclimatization and dimensioning. Different equipment used in each stage of production. Methods of testing of plywood. Grading and plywood storage

WPE 409: Sawmilling **(2 Units E: LH 15; PH 45)**

Learning Outcomes
At the end of this course, the students should be able to:
1. discuss the various types of machines used in log processing;
2. explain the methods of log conservation and conversion; and
3. learn ways of preventing possible accidents in a typical sawmill and while taking safety precautions.

Course Contents
Wood log yard. Grading or sorting of wood. Preservation of logs. Determination of sawing patterns. Sawing of wood. Resawing. Sorting, grading and storage of boards. Production measurements in mills. Mill efficiency. Sawing equipment in the sawmill.

WPE 411: Furniture Design and Production **(2 Units, E: LH 15 PH 45)**

Learning Outcomes
At the end of this course,the students should be able to:
1. identify the various requirements for design of furniture for various end-uses;
2. classify the functions of various tools and equipment for furniture production;
3. construct and test wood joints; and
4. explain the principles of furniture design and the use software such as Auto-CAD, Pro 100 furniture design.

Course Contents
Classification of furniture products. Principle of furniture design. Design interpretation. Raw materials in furniture production. Production conditions and interchangeability (dimensions, deviations, tolerance and classes of precision). Operation sequence, machines and formation of components parts, assembly of furniture parts. Furniture finishing processes.

500 Level

GET 501: Engineering Project Management (3 Units C: LH 45)

Learning Outcomes

At the end of the course, students should be able to:

1. explain the basics of project management as it relates to the Engineering discipline;
2. demonstrate knowledge and understanding of engineering, management and financial principles and apply these to their own work, as a member and/or leader in a team, to manage projects and in multi-disciplinary environments;
3. conduct, manage and execute projects in multi-disciplinary areas;
4. possess the skills needed for project management; and
5. work within the budget when executing a project for proper management.

Course Contents

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness;decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 502: Engineering Law (2 Units C: LH 30)

Learning Outcomes

Students will be able to:

1. describe and explain the basic concept, sources and aspects of law;
2. describe and explain the major differences between the various categories of law, courts and legal jurisdictions;
3. describe and explain legal principles and their application in professional engineering design and management services and their professional liability implications; and
4. develop reasoned analysis of real-life or hypothetical engineering scenarios using the legal principles undertake critical analysis of reliable information to develop, and practically present technical reports for use in varying judicial/quasi-judicial settings including as an expert witness.

Course Contents

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

WPE 511: Final Year Project **(6 Units C: PH 270)**

Learning Outcomes
At the end of this course/project, the students should be able to:
1. undertake and complete successfully an independent or team project;
2. source for information for engineering work; and
3. communicate the outcome and implications of engineering work.

Course Contents
Final year research project will be undertaken by individual students under the supervision of members of staff. A report of the research work will be presented in form of a dissertation to be followed by an oral examination.

Minimum Academic Standards
Equipment
List of Minimum Equipment, Tools, Laboratories

1. a standard wood workshop with basic cutting machines which include: universal circular saw, planning machine, spindle moulder or router machine, narrow band saw, wood turning lathe, hand tools for wood workshop;
2. a laboratory equipped with universal testing machine, in addition to normal basic laboratory facilities such as glass wares (pipettes, burettes, oven, measuring balances, scales.); and
3. laboratory size sawing machine, peeling machine, slicing machine, hammer mill, and single day-light press.

S/No.	Equipment
	Measuring Tools and Instruments
1	Pocket rule with belt clip (235m)
2	Steel measuring tape caliper rule
3	Procession external micrometer
4	Universal measuring instrument for depth measurement
5	Procession inside micrometer
6	Dial indicator
7	Outside spring caliper
8	Inside spring caliper
9	Metal bar divider
10	Precision tri square
30	Technician tool box (empty)
	Woodwork Equipment

1	Band saw-table size-700 x 980mm - 3hp
2	Radial arm saw 3hp (with extra blade)
3	Circular saw-blade dia-400mm with external blades
4	Universal woodworker combined-4hp seven works model
5	Single cylinder planner-4hp (surface planner with extra blades)
6	Vertical Motorize-chain motorise-3hp with extra bits
7	Router drilling machine-3hp
8	Combined tennoning and scribing machine
9	Belt sanding machine-2hp (with extra sanding paper reels)
Hand Tools (Carpentry)	
1	Marking gauge
2	Mortise gauge
3	B. spirit level universal
4	Motorize chisel-(6.4, 9.6, 12.7, 16) mm
5	Flat chisel-(6.4, 9.6, 12.7, 16) mm
6	Bevel edge chisel – (6.4, 9.6, 12.7, 16) mm
7	Round chisel (6.4, 9.6, 12.7, 16) mm
8	Smooth plane-jack plane, plough plane
9	Wood rasp
10	Hand saw or panel saw
11	Ripsaw, crosscut
12	C- Clamp
13	F- Clamp
14	Wood bench vice
15	Jack plane
16	Hand drilling machine/rachet brazed bits
17	Sanding machine-heavy duty
18	Surface and thickness (100-150) mm blade
19	Extra knives carpentry machine planner and thicknesser
20	Air compressor-tank capacity 500 litres complete with accessories-type spray gun and air blow-gun
21	Hydraulic garage jack (1, 2, 6 ton)
22	Hydraulic workshop crane (2.5 tones)
23	Battery tester, cell tester, acid tester
24	Battery fast and slow charger (6-24V,20Λ)
25	Battery service equipment
26	Spark plug tester and cleaner
27	Hydraulic mobile crane (1.5 – 5tons)
28	Wire rope winch- (1500 – 3000kg)
29	Chain host

Engineering Graphics and Design Studio

S/No.	Equipment
1	50 Computer work stations with design and graphic software from the AutoCad suite (FUSION 360, etc.), 3-D printers and accessories.
2	50 drawing boards and T-squares
3	Large screen and projector

Staffing

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 15 Units per semester for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

NUC requirement encourages all academic staff to have PhD degrees, hence appointment of academic staff is preferably to the Lecturer cadre. Only in exceptional cases are candidates with great promise appointed to Graduate Assistant and Assistant Lecturer positions for the purpose of being developed to the Lecturer cadre as registered PhD candidates.

Academic Support Personnel

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

Administrative Support Staff

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

Technical Support Personnel

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

Minimum Number of Staff

Subject to the general standards specified by NUC;

1. there should be a minimum of two PhDs and four M.Eng degree holders full-time academic staff to mount the programme;
2. each workshop or laboratory should have an adequate number of staff with the right mix, such that each unit or section in that workshop or laboratory can run efficiently; and
3. there should be an adequate number of administrative staff of the appropriate calibre for the office of the Head of Department to run.

Student/Staff Ratio

The minimum staff-to-student ratio should be 1:15 from 200 level to 500 level.

Library

Aside from the university library, there must be well stocked library for the Department of Wood Products Engineering.

There must be adequate library facilities to cater for the interest of all the programmes in the Department. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications in sufficient numbers.

Classrooms, Laboratories, Workshops, Clinics and Offices
Academic and Non-Academic Spaces

The NUC recommends the following physical space requirement:

Academic	**m^2**
Professor's Office	18.50
Head of Department's Office	18.50
Tutorial Teaching Staff Space	13.50
Other Teaching Staff Space	7.00
Technical Staff Space	7.00
Science Staff Research Laboratory	16.50
Engineering Staff Research Laboratory	14.50
Seminar Space per student	1.85
Drawing Office Space (A.O. Board) (Per Student)	4.60
Drawing Office Space (A.I. Board) (Per Student)	3.70
Laboratory Space	7.50
Non-Academic	
Secretarial Space	7.00

Office Facilities

The requirements for office accommodation are:
1.13 academic offices on paper
2. 1 professorial type in the department. Size: each of the office is about 13.5 m

S/No	**Office**	**No in Room**	**Facilities**
1.	HOD	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
2.	Professor	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit, Secretary and facilities.
3.	Reader	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
4.	Senior Lecturer	1	Table, chairs, A/C, filing cabinet, bookshelves, computer unit.
5.	Lecturer I	2	Table, chairs, fan, filing cabinet, bookshelves.
6.	Lecturer II	3	Table, chairs, fan, filing cabinet, bookshelves