**Bayero University, Kano**

**Department of Physics**

**PHYSICS WITH ELECTRONICS**

**30% Additional Courses to CCMAS**

**Summary**

**100 Level**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-BIO101 | General Biology I | 2 | E | 30 | - |
| BUK-BIO102 | General Biology II | 2 | E | 30 | - |
| BUK-BIO107 | General Biology Practical I | 1 | E | - | 45 |
| BUK-BIO108 | General Biology Practical II | 1 | E | - | 45 |
| BUK-CHM101 | General Chemistry I | 2 | E | 30 | - |
| BUK-CHM102 | General Chemistry II | 2 | E | 30 | - |
| BUK-CHM107 | General Chemistry Practical I | 1 | E | - | 45 |
| BUK-CHM108 | General Chemistry Practical II | 1 | E | - | 45 |
| BUK-MTH103 | Elementary Mathematics III | 2 | C | 30 | - |
| BUK-STA112 | Probability I | 3 | C | 45 | - |
|  | **Total** | **17** |  |  |  |

**200 Level**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-COS201 | Computer Programming I | 2 | C | 30 | - |
| BUK-MTH201 | Mathematical Methods I | 2 | C | 30 | - |
| BUK-MTH202 | Elementary Differential Equations | 2 | C | 30 | - |
| BUK-PHY201 | General Physics V (Modern Physics) | 2 | C | 30 | - |
| BUK-PHY202 | Introduction to Electric Circuits and Electronics | 2 | C | 30 | - |
| BUK-PHY207 | General Physics Practical | 1 | C |  | 45 |
| BUK-PHY208 | General Physics Practical | 1 | C |  | 45 |
| BUK-STA211 | Probability II | 3 | C | 45 | - |
| BUK-STA202 | Statistic for Science and Engineering | 3 | C | 45 | - |
| BUK-PYE220 | Electronics and IT Workshop | 2 | C | 15 | 30 |
| BUK-PYE221 | Introduction to Electronics: Digital and Analog Circuits | 2 | C | 30 |  |
|  | **Total** | **22** |  |  |  |

**300 Level**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-MTH304 | Complex Analysis I | 2 | C | 30 | - |
| BUK-PHY318 | Semiconductor Devices | 3 | C | 45 | - |
| BUK-PYE320 | Electronics Practical (Digital) | 1 | C | - | 45 |
| BUK-PYE321 | Introduction to Embedded Systems | 2 | C | 30 | - |
| BUK-PYE322 | Industrial Electronics Design | 2 | E | 30 | - |
| BUK-PYE323 | Power Electronics | 2 | C | 30 | - |
|  | **Total** | **8** |  |  |  |

**400 Level**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-PYE430 | Communication Systems and Principles | 2 | C | 30 |  |
| BUK-PYE431 | Introduction to Nanoelectronics | 2 | C | 30 | - |
| BUK-PYE432 | Control Systems and Automation | 2 | C | 30 | - |
| BUK-PYE433 | Data Communication and Networking | 2 | E | 30 | - |
| BUK-PYE434 | Artificial Intelligence and Applications | 2 | E | 30 | - |
| BUK-PYE435 | Signals and Systems | 2 | C | 30 | - |
| BUK-PYE436 | Quantum Electronics and Computing | 2 | E | 30 |  |
| BUK-PYE437 | Digital Signal Processing | 2 | E | 30 |  |
|  | **Total** | **18** |  |  |  |

BUK-**BIO 101: General Biology I**  (**2 units C: LH 30)**

**Senate-Approved Relevance**

Training of high-quality graduates that are well skilled and knowledgeable in the required biological skills in Nigeria is in line with BUK’s mission to address environmental and developmental challenges in producing graduates in physics with electronics.

**Overview**

This course is important to provide trained and skilled manpower to manage differentcategories of plants and animals and their environment. The philosophy of this course is to understand the plants and animals and their environment to sustain their population for socio-economic and development of humanity.

This course is designed to introduce and prepare students to have strong background knowledge Biology ahead of various physics with electronics courses in medical electronics/physics, biophysics, design, process, and production. The importance of the course lies in addressing African environmental and developmental challenges. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of this course are to:

1. Describe cell structure and organization
2. Discuss the characteristics of living things
3. Describe heredity and evolution
4. State Mendelian laws
5. Describe the various types of habits

**Learning Outcomes**

At the end of lectures, students should be able to:  
1. Explain cells structures and organizations;  
2. Summarize functions of cellular organelles;  
3. Characterize living organisms and state their general reproduction.

4 Describe the interrelationship that exists between organisms.

5.Discuss the concept of heredity and evolution; and

6. Enumerate habitat types and their characteristics.

**Course Contents**

Cell structure and organization, functions of cellular organelles. characteristics and classification of living things. chromosomes, genes; their relationships and importance. general reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). heredity and evolution (introduction to Darwinism and Lamarkism, Mendelian laws, explanation of key genetic terms). elements of ecology and types of habitat.

**Minimum Academic Standards**

As contained in BSc. Biology CCMAS

BUK-**BIO 102: General Biology II Learning Outcomes** (**2 Units C: LH 30)**

**Learning Outcomes**

At the end of the lectures, students should be able to:  
1. List the characteristics, methods of identification and classification of Viruses, bacteria andfungi;  
2. State the unique characteristics of plant and animal kingdoms;  
3. Describe ecological adaptations in the plant and animal kingdoms;  
4. Explain nutrition, respiration, excretion and reproduction in plants and animals; and

5. Describe growth and development in plants and animals.

**Course Contents**

Basic characteristics, identification and classification of viruses, bacteria and fungi.  
A generalized survey of the plant and animal kingdoms based mainly on the study of similarities and differences in the external features. Ecological adaptations. Briefs on physiology to include nutrition, respiration, circulatory systems, excretion, reproduction, growth and development.

BUK-**BIO 107: General Biology Practical I (1 Unit C: PH 45)**

**Learning Outcomes**

At the end of this course students should be able to:  
1. Outline common laboratory hazards;  
2. Provide precaution on laboratory hazards;  
3. State the functions of the different parts of microscope;

4. Use the microscope and describe its maintenance;

5. Draw biological diagrams and illustrations; and  
6. Apply scaling and proportion to biological diagrams.

**Course Contents**

Common laboratory hazards. prevention and first aid. measurements in biology. uses and care of microscope. compound and dissecting microscope. Biological drawings and illustration, scaling, accuracy and proportion. use of common laboratory apparatus and laboratory experiments designed to illustrate the topics covered in **BIO 101.**

**BIO 108: General Biology Practical II (1 Unit C: PH 45)**

**Learning Outcomes**

At the end of this course, students should be able to:  
1. Describe the anatomy of flowering plants;  
2. Differentiate types of fruit and seeds;  
3. State ways of handling and caring for biological wares;

4. Describe the basic histology of animal tissues; and

5. Identify various groups in the animal kingdom.

**Course Contents**

Anatomy of flowering plants, primary vegetative body. stem, leaf and root to show the mature tissues namely parenchyma, collenchyma, sclerenchyma, xylem and phloem. Types of fruits and seeds. Care and use of dissecting kits and other biological wares. Dissection and general histology of animal tissues based on vertebrate forms. Morphology and functions of epithelial, muscular, nervous and connective tissues. Examination of various groups of lower invertebrates under microscopes, identification of various groups of organisms in Animal Kingdom. Andany experiment designed to emphasize the practical aspects of topics in BIO 102.

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

**Senate-Approved Relevance**

General Chemistry I as a course deal mainly with the basic chemical techniques involved in collection, preservation, and preparation of physical materials. It offers a wide range of tailored practical experience that deliver field or lab-based methods in training specific to groups of taxa or specific kinds of method that enhances the field skills. It is requiring a hands-on approach to expose the students to modern techniques and methodologies making the students well versed with these protocols and methods. This is in line with the BUK mission and vision to produce graduates that will be locally and globally relevant.

**Overview**

General Chemistry I form the foundation for the chemical aspects of physical quantities that will aid future physics and electronics students in developing and advancing their knowledge.

This course is designed to introduce and prepare physics with electronics students for the various chemical natures of physical quantities in design, process, and production. The importance of the course lies in meeting the need for sustainable development. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The main objectives of the course are to:

1. Define atom, molecules and chemical reactions.
2. State the modern electronic theory of atoms.
3. Discuss balance oxidation – reduction equation
4. State the characteristics of acids, bases, and salts
5. State principles of equilibrium to aqueous systems
6. State Le Chatelier’s principle

**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. Justify the trends of atomic radii, ionization 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. Illustrate shapes of simple molecules and hybridized orbitals;  
7. Identify the characteristics of acids, bases and salts, and solve problems based on theirquantitative 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. Hybridization and shapes of simple molecules. Valence Forces and 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.

**Minimum Academic Standards**

As contained in BSc. Chemistry CCMAS

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

**Senate-approved Relevance**

General chemistry II is a course (continuation of CHM102) deal mainly with the basic chemical techniques involved in collection, preservation and preparation of physical materials. It offers a wide range of tailored practical experience that deliver field or lab-based methods in training specific to particular groups of taxa or specific kinds of method that enhances the field skills. It is requiring a hands-on approach to expose the students to modern techniques and methodologies making the students well versed with these protocols and methods. This is in line with the BUK mission and vision to produce graduates that will be locally and globally relevant.

**Overview**

General Chemistry II is the second part of the chemistry course that form the foundation for the chemical aspects of physical quantities that will aid future physics and electronics students in developing and advancing their knowledge.

This course is also designed to introduce and prepare physics with electronics students for the various chemical natures of physical quantities in design, process, and production. The importance of the course lies in meeting the need for sustainable development. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The main objectives of the course are to:

1. State the importance and development of organic chemistry.
2. Define fullerenes and their applications.
3. State electronic theory.
4. Describe rules guiding nomenclature and functional group classes of organic chemistry
5. Identify classes of organic functional group with brief description of their chemistry
6. Discuss comparative chemistry of group 1A, IIA and IVA elements.
7. Describe basic properties of transition metals

**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. Describe rules guiding nomenclature and functional group classes of organic chemistry;
6. Determine 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 and 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.

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

**Senate-Approved Relevance**

General practical chemistry I as a course deal mainly with the basic practical chemical techniques involved in collection, preservation and preparation of physical materials. It offers a wide range of tailored practical experience that deliver field or lab-based methods in training specific to particular groups of taxa or specific kinds of method that enhances the field skills. It is requiring a hands-on approach to expose the students to modern techniques and methodologies making the students well versed with these protocols and methods. This is in line with the BUK mission and vision to produce graduates that will be locally and globally relevant.

**Overview**

Introductory practical Chemistry I form the foundation for the chemical practical aspects of physical quantities that will aid future physics and electronics students in developing and advancing their knowledge.

This practical course is designed to introduce and prepare physics with electronics students for the various practical in chemical natures of physical quantities in design, process, and production. The importance of the course lies in meeting the need for sustainable development. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The main objectives of the course are to:

1. Discuss the general laboratory rules and safety procedures
2. State the basic glassware and equipment in the laboratory
3. Differentiate between primary and secondary standards
4. Describe observations and measurements in the laboratory notebooks
5. Evaluate data to arrive at scientific conclusions

**Learning Outcomes**

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

1. Describe the general laboratory rules and safety procedures;
2. Collect scientific data and correctly carrying out Chemical experiments;
3. Identify the basic glassware and equipment in the laboratory;
4. Identify the differences between primary and secondary standards;
5. Perform redox titration;
6. Recording 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.

**Minimum Academic Standards**

As contained in BSc. Chemistry CCMAS

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

**Senate-approved Relevance**

General practical chemistry II is the second practical course that deal mainly with the basic practical chemical techniques involved in collection, preservation and preparation of physical materials. It offers a wide range of tailored practical experience that deliver field or lab-based methods in training specific to particular groups of taxa or specific kinds of method that enhances the field skills. It is requiring a hands-on approach to expose the students to modern techniques and methodologies making the students well versed with these protocols and methods. This is in line with the BUK mission and vision to produce graduates that will be locally and globally relevant.

**Overview**

General practical Chemistry II form the foundation for the chemical practical aspects of physical quantities that will aid future physics and electronics students in developing and advancing their knowledge.

This practical course is also designed to introduce and prepare physics with electronics students for the various practical in chemical natures of physical quantities in design, process, and production. The importance of the course lies in meeting the need for sustainable development. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The main objectives of the course are to:

1. Classify the general laboratory rules and safety procedures
2. Identify the basic glassware and equipment in the laboratory
3. Describe preliminary tests which includes ignition, boiling point, melting point, test on known and unknown organic compounds
4. Describe solubility tests on known and unknown organic compounds
5. Explain elemental tests on known and unknown compounds

**Learning Outcomes**

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

1. Identify the general laboratory rules and safety procedures;
2. Collect scientific data and correctly carrying out Chemical experiments;
3. Identify the basic glassware and equipment in the laboratory;
4. Identify and carry out preliminary tests which includes ignition, boiling point, melting point, test on known and unknown organic compounds;
5. Perform solubility tests on known and unknown organic compounds;
6. Conduct elemental tests on known and unknown compounds; and
7. Conduct 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.

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

**Senate-approved relevance**

Training of high-quality graduates that are well skilled and knowledgeable in the required mathematical skills in Nigeria is in line with EDSU’s mission to address African developmental challenges in producing graduates in chemical engineering.

**Overview**

Vectors coordinate geometry and dynamic is a vital course which prepares the graduate in chemical engineering to be able to handle and improve on the infrastructural deficit for sustainable development. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to solve problems which they will encounter in the course of their training.

This course is designed to introduce and prepare students ahead of various chemical engineering courses in design, process and production. The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. Explain types of vectors, geometrical representation of vectors, components of vectors
2. Illustrate linear dependence of vectors and its simple application
3. Demonstrate dimensional coordinates systems
4. Analyse equation of circle, tangent and normal to a circle.
5. Describe the properties of parabola, ellipse, hyperbola, straight lines and planes in space
6. Comprehend the components of velocity and acceleration of a particle moving in a plane
7. Describe and justify force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, angular momentum and simple harmonic motion
8. Describe elastic string, simple pendulum, impulse
9. Analyse impact of two smooth spheres and of a sphere on a smooth surface

**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

3. Solve differentiation and integration of vectors.

**Course Contents**

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.

**Minimum Academic Standards**

As contained in BSc. Mathematics CCMAS

BUK-**STA 112: Probability I (3 Units C: LH 45)**

**Senate-approved relevance**

Training of high-quality graduates that are well skilled and knowledgeable in handling and analysing statistical data is in line with BUK’s mission to address African developmental challenges in producing graduates in physics with electronics.

**Overview**

Introductory statistics is a vital approach used in handling data obtained from different processes, operations and experiment in physics with electronics. It is designed to introduce and expose students to various statistical tools required in computing and analysing data. Also, to build the capacity of students in the area of data analysis formulating reinforced electronics materials in the midst of abundance of untapped raw materials.

The importance of the course lies in meeting the need in achieving sustainable development goals (SDGs) numbers 1 and 2 in the areas of reducing poverty and zero hunger respectively. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Objectives**

The objectives of the course are to:

1. Describe measures of location in simple and group data
2. Discuss measures of dispersion in simple and group data
3. Discuss exponential, elements of probability distribution; Normal, binomial, Poisson, geometrics and negatives binomial distributions
4. Describe estimate and tests hypothesis concerning the parameters of distributions.
5. Analyse regression, correlation, and analysis of variable contingency table non-parametric inference

**Learning Outcomes**

At the end of the course students should be able to  
1. Explain the differences between permutation and combination;  
2. Explain the concept of random variables and relate it to probability and distribution functions

3.Describe the basic distribution functions; and  
4. Explain the concept of exploratory data analysis.

**Course Contents**

Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

**Minimum Academic Standards**

As contained in BSc. Statistics CCMAS

BUK-**COS 201: Computer Programming I (3 Units C1: LH 30; PH 45)**

**Senate Approved Relevance**

To graduate students introduced to **computer programming** adequately equipped to independently interpret, write and debug computer programs capable of solving specific tasks. Relevance is seen in producing graduates that contributes to the technological improvement of life in accordance with the mission and vision of Bayero University, Kano.

**Overview**

The course provides introduction to programming paradigm and computer programming. The course begins by providing introduction to data types and strings, then design and implement programming using selection and loops. It also provides introduction to object oriented programming (OOP).

**Objectives**

The objectives of the course are to;

1. Provide introduction programming paradigms and their approaches to programming;
2. Provide programmes using basic data types and strings
3. Provide basis to design and implement programming problems using selection
4. Provide basis to design and implement programming problems using loops
5. Provide basis to use and implement classes in an object-oriented approach
6. Provide basis to implement simple exception handling in programmes
7. Provide basis to develop programmes with input/output from text files; and
8. Provide basis to design and implement programming problems involving arrays

**Learning Outcomes**

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

1. identify different programming paradigms and their approaches to programming;

2. write programmes using basic data types and strings;

3. design and implement programming problems using selection;

4. design and implement programming problems using loops;

5. use and implement classes as data abstractions in an object-oriented approach;

6. implement simple exception handling in programmes.

7. develop programmes with input/output from text files; and

8. design and implement programming problems involving arrays.

**Course Contents**

Introduction to computer programming. Functional programming; Declarative programming; Logic programming; Scripting languages. Introduction to object-orientation as a technique for modelling computation. Introduction of a typical object-oriented language, such as Java. Basic data types, variables, expressions, assignment statements and operators. Basic object-oriented concepts: abstraction; objects; classes; methods; parameter passing; encapsulation. Introduction to Strings and string processing; Simple I/O; control structures; Arrays; Simple recursive algorithms; inheritance; polymorphism.

**Lab work**: Programming assignments involving hands-on practice in the design and implementation of simple algorithms such as finding the average, standard deviation, searching and sorting. Practice in developing and tracing simple recursive algorithms. Developing programmes involving inheritance and polymorphism.

**BUK-PYE220: Electronics and IT workshop (2 Units C: LH 15, PH 30)**

**Senate Approved Relevance**

To graduate students that are introduced to **Electronics and IT workshop who are** adequately trained to conduct practical works in workshop. The workshop also provides basic theoretical background in addition to practical in the workshop. Relevance is seen in graduating students exposed to practical work for the technological improvement of life to fulfil the mission and vision of Bayero University, Kano.

**Overview**

The workshop begins by providing basic theoretical background to the key branches of electronics namely power, communication, analogue and digital before embarking on practicals in the workshop.

**Objectives:** The objectives of the course are to;

1. Provide basis for understanding workshop best practices
2. Provide basis for appreciating the theories governing the operations of several electronics and IT systems
3. Provide basis for transforming ideas into projects
4. Provide basis for developing circuit boards
5. Provide basis for using softwaretools to design electronics circuits
6. Provide basis for developing schematic circuits into hardware prototypes

**Learning Outcomes**

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

1. Identify circuit diagrams and symbols;
2. Design circuits using circuit design tools like Altium, KiCAD, proteus, eagleview, etc;
3. Apply potential divider and current divider techniques in calculating circuit potential differences and branch currents;
4. Design small office home office (SOHO) computer networks such as LAN/WLAN
5. Troubleshoot and repair computer hardware and software
6. Troubleshoot and maintain computer SOHO networks

**Course Contents**

Introduction to electronic circuit design. Introduction to simulation tools (Simulink, Multism, electronic workbench etc). Introduction to embedded systems. Programming embedded systems using C++/C and Flowcode. PCB design. Mini project (electronics). Introduction to computer hardware and software. Troubleshooting and repair of hardware/software (memory, CPU, OS and application software). Introduction to computer networks. LAN/WLAN design. Cabling (terminating RJ 45 and RJ 11) standard. SOHO router configuration. Introduction to netwok simulators (packet tracer). Network configuration. Design and implementation of Wireless network. Troubleshooting networks. IT project management.

BUK-**MTH 201: Mathematical Methods I (2 Units C: LH 30)**

**Senate Approved Relevance**

To graduate students that are introduced the **Mathematical Methods** who are expected to develop capacity of questioning and rational thinking in the use of calculus. The students are to develop an understanding of physical world involving derivatives (rates of change) using calculus for the scholarly improvement of life to fulfil the mission and vision of Bayero University, Kano.

**Overview**

The course provides an introduction to mathematical methods used for understanding and analysing physical world involving rate of change. It also provides a basis for understanding and utilizing derivatives and integrals in modelling physical processes in addition to providing basis for explaining real variable based real value problems.

**Objectives**

The objectives of the course are to;

1. Provide basis for understanding physical world involving rates of change
2. Provides basis for understanding derivatives and integrals in modelling physical processes.
3. Provide explanations for real variable based real-valued functions.
4. Highlight the key mathematical ideas necessary for calculus based physics problems.
5. Provide basis for solving real variable based real-valued functions.
6. Provide basis for solving line, surface, and volume integrals

**Learning Outcomes**

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

1. Explain real-valued functions of a real variable.

2. Solve some problems using mean value theorem and Taylor series expansion; and

3. Evaluate line integral, surface integral and volume integrals.

**Course Contents**

Real-valued functions of a real variable. Review of differentiation and integration and their applications. Mean value theorem. Taylor series. Real-valued functions of two and three variables. Partial derivatives chain rule, extrema, lagrangian multipliers. Increments, differentials, and linear approximations. Evaluation of line integrals. Multiple integrals.

BUK-**MTH 202: Elementary Differential Equations (2 Units C: LH 30)**

**Senate Approved Relevance**

To graduate students that are introduced to the **basics** of elementary Differential Equations and adequately equipped with the knowledge to analyse simple problems involving simple differential equations. Also, graduates of expected to develop capacity of questioning and rational thinking in the use of calculus. Relevance is seen in understanding of physical world involving derivatives (rates of change) for the technological improvement of life to fulfil the mission and vision of Bayero University, Kano.

**Overview**

The course provides an introduction to differential equations used for physical and geometry problems. It also provides a basis for solving first and second order differential equations.

**Objectives**

1. Define order and degree of a differential equation;
2. Provide techniques for solving first and second order differential equations.
3. Provides basis for understanding order of degree of differential equations.
4. Provide basis for solving physics related problems and
5. Provide basis for solving geometry related problems.

**Learning Outcomes**

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

1. Define the following: order and degree of a differential equation;

2. Describe some techniques for solving first and second order linear and non-linear equations;

3. Solve some problems related to geometry and physics.

**Course Contents**

Derivation of differential equations from primitive geometry, physics etc. Order and degree of differential equation. Techniques for solving first and second order linear and non-linear equations. Solutions of systems of first order linear equations. Finite linear differential equations. Application to geometry and physics.

BUK-**STA 202: Statistics for Physical Sciences and Engineering (3 Units C: LH 45)**

**Senate Approved Relevance**

To graduate students groomed to utilize **Statistics in Sciences and Engineering applications** with developed capacity in questioning and rational thinking in its use in prediction. The students shall develop an understanding of physical world using involving derivatives (rates of change) using calculus for the technological improvement of life to fulfil the mission and vision of Bayero University, Kano. The course will widen the understanding of the graduates on the operations of embedded systems and principles upon which embedded devices operate with a view to reproduce and or modify the devices, leading to identification and development of new devices and application areas.

**Overview**

The course provides further knowledge on statistical methods in physical sciences and engineering, measures of location, partition and dispersion. It explains the elements of probability; probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal poisson, geometric, hypergeometric, negative-binomial, normal, Student’s t and chi-square distribution; It also differentiate point from internal estimation and could be able to tests for hypotheses concerning population means proportions and variances.

**Objectives**

The objectives of the course are to;

1. Provide basis for understanding measures of location, partition and dispersion;
2. Explain the elements of probability; probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal poisson, geometric, hypergeometric, negative-binomial, normal, Student’s t and chi-square distribution;
3. Differentiate point from internal estimation that could be used to tests for hypotheses concerning population means proportions and variances
4. Compute for regression and correlation
5. Conduct some non–parametric tests with reference to contingency table analysis; and
6. Explain the elements of design of experiments and analysis of variance

**Learning Outcomes**

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

1. Highlight the scope for statistical methods in physical sciences and engineering

2. Define the measures of location, partition and dispersion

3. Explain the elements of probability; probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal poisson, geometric, hypergeometric, negative-binomial, normal, Student’s t and chi-square distribution;

4. Differentiate point from internal estimation and could be able to tests for hypotheses concerning population means proportions and variances;

5. Compute for regression and correlation as well as conduct some non–parametric tests with reference to contingency table analysis; and

6. Explain the elements of design of experiments and analysis of variance.

**Course Contents**

Scope for statistical methods in physical sciences and engineering. Measures of location, partition and dispersion. Elements of probability. Probability distribution: binomial Poisson, geometric, hypergeometric, negative-binomial, normal poisson, geometric, hypergeometric, negative-binomial, normal, Student’s t and chi-square distributions. Estimation (point and internal) and tests of hypotheses concerning population means proportions and variances. regression and correlation. non-parametric tests. contingency table analysis. introduction to design of experiments. analysis of variance.

BUK-**STA 211: Probability II (3 Units C: LH 45)**

**Senate Approved Relevance**

To graduate students groomed to utilize **Statistics in Sciences and Engineering applications** with developed capacity in questioning and rational thinking in its use in prediction. The students shall develop an understanding of physical world using involving derivatives (rates of change) using calculus for the technological improvement of life to fulfil the mission and vision of Bayero University, Kano. The course will widen the understanding of the graduates on the operations of embedded systems and principles upon which embedded devices operate with a view to reproduce and or modify the devices, leading to identification and development of new devices and application areas.

**Overview**

The course explains further permutation and combination and define probability laws, conditional probability, and independence; describe Bayes’ theorem and explain some of the basic probability distribution for discrete and continuous random variables. It provides basis for computing expectations and moments of random variables, explains the applications Chebyshev’s inequality to real life situations. It also explains joint marginal and conditional distributions and moments as well as limiting distributions, standard distributions, moments and moment-generating functions, laws of large numbers and the central limit theorem.

**Objectives**

The objectives of the course are to;

1. Explain further permutation and combination;
2. Define probability laws, conditional probability, and independence;
3. Describe Bayes’ theorem and explain some of the basic probability distribution for discrete and continuous random variables;
4. Compute expectations and moments of random variables;
5. Explain Chebyshev’s inequality and apply it to real life situations;
6. Explain joint marginal and conditional distributions and moments as well as Limiting distributions;
7. Describe standard distributions, moments and moment-generating functions; and
8. Explain laws of large numbers and the central limit theorem.

**Learning Outcomes**

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

1. Explain further permutation and combination;

2. Define probability laws, conditional probability, and independence;

3. Describe Bayes’ theorem and explain some of the basic probability distribution for discrete and continuous random variables;

4. Compute expectations and moments of random variables;

5. Explain Chebyshev’s inequality and apply it to real life situations;

6. Explain joint marginal and conditional distributions and moments as well as Limiting distributions;

7. Describe standard distributions, moments and moment-generating functions; and

8. Explain laws of large numbers and the central limit theorem.

**Course Contents**

Further permutation and combination. probability laws. conditional probability, independence. Bayes’ theorem. probability distribution of discrete and continuous random variables: binomial, Poisson, geometric, hypergeometric, rectangular (uniform), negative exponential, binomial. Expectations and moments of random variables. Chebyshev’s inequality. joint marginal and conditional distributions and moments. limiting distributions. discrete and continuous random variables, standard distributions, moments and moment-generating functions. laws of large numbers and the central limit theorem.

BUK-**PHY 201: General Physics IV (Elementary Modern Physics) (2 Units C: LH 30)**

**Senate Approved Relevance**

To graduate students who appreciates defects in Newtonian Mechanics and introduced to Galilean relativity, inertial frames, quanta. Bohr's theory of atomic structure. Energy levels and spectra. De Broglie hypothesis. The uncertainty principle. Black body radiation. The momentum operator. Time-independent Schrödinger equation. The infinite square well. Simple applications in particle and nuclear physics. Compton effect. Thermionic emission. Radioactivity. Detection and measurement of charged particles (including the treatment of detectors). X-rays the **basics** of elementary Differential Equations and adequately equipped with the knowledge to analyse simple problems involving simple differential equations. Also, graduates of expected to develop capacity of questioning and rational thinking in the use of calculus. Relevance is seen in the understanding of physical world by incorporating relativity, Compton effect to fulfil the mission and vision of Bayero University, Kano.

**Overview**

The course introduces the concept of inertial frame, and relates the limitations imposed by motion of bodies at speed of light. It also provides an introduction to the principles of special relativity and their usage in deriving relations for time dilation and length contraction.

**Objectives:**

The objectives of the course are to;

1. Provide an introduction to the notion of an inertial frame and the concept of an observer
2. Provide basis for relating the limitations imposed by the consequences of motion of bodies at speed of light.
3. Provides basis for understanding the principles of special relativity
4. Provide basis for solving calculations involving Lorentz transformation and
5. Provide basis for deriving relativistic energy and momentum and their usage in solving problems.

**Learning Outcomes**

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

1. Explain the notion of an inertial frame and the concept of an observer;

2. Relate the limitations imposed by and consequences of motion of bodies at the speed of light;

3. State the principles of Special Relativity and use them to derive relations for time dilation and length contraction;

4. Perform calculations using the Lorentz transformation formulae;

5. Derive relativistic energy and momentum and use these to solve problems in mechanics;

6. Apply the mathematical treatment of the wave function and Schrodinger’s equation;

7. Relate the atomic structure and energy associated with the particles of the atom;

8. Apply the ideas of a wave-particle duality and the uncertainty principle to solve problems in quantum mechanics;

9. Apply the Bohr formula to calculate energies and wavelengths in the context of atomic hydrogen; and

10. Explain the interaction of photons and electrons with matter.

**Course Contents**

Defects in Newtonian Mechanics. Galilean relativity. The speed of light. Inertial frames and the concept of an observer. The principles of Einstein’s Special Theory of Relativity. Lorentz transformation. Time dilation and length contraction. Transformation of velocities. Doppler effect. Relativistic energy and momentum. Basic properties of atoms and molecules. Experimental basis of quantum theory. Electrons and quanta. Bohr's theory of atomic structure. Energy levels and spectra. De Broglie hypothesis. The uncertainty principle. Black body radiation. The momentum operator. Time-independent Schrödinger equation. The infinite square well. Simple applications in particle and nuclear physics. Compton effect. Thermionic emission. Radioactivity. Detection and measurement of charged particles (including the treatment of detectors). X-rays.

BUK-**PHY 202: Introduction to Electric Circuits and Electronics (2 Units C: LH 30)**

**Senate Approved Relevance**

To graduate students that are introduced to **Electric circuits and the field of electronics who are** adequately equipped with relevant circuit laws to analyse simple electric circuits. Relevance is seen in synthesizing electric circuits for the technological improvement of life to fulfil the mission and vision of Bayero University, Kano.

**Overview**

The course provides an introduction to alternating and direct current based electric circuits. It also provides an introduction to semiconductors necessary for understanding electronics.

**Objectives:**

The objectives of the course are to;

1. Provide basis for understanding electric circuit laws;
2. Provide basis for solving complex resistor networks.
3. Provide techniques for solving linear electric circuits
4. Provide basis for determining power and energy dissipation of electric circuits.
5. Provide basis for solving ac and dc circuits
6. Provide basis for solving geometry related problems

**Learning Outcomes**

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

1. Identify circuit diagrams and symbols;

2. Determine current flows, potential drops, power, and energy dissipation in circuits using Ohm’s law;

3. Simplify series and parallel combinations of resistors;

4. State Kirchhoff’s laws and apply same in solving for currents and voltages in dc. and ac. circuits;

5. Apply potential divider and current divider techniques in calculating circuit potential differences and branch currents;

6. State and apply circuit theorems and principles to solve problems;

7. Apply the Mesh currents and Node – Voltage methods in network analysis;

8. Discuss the nature of ac. currents and voltages in resistors, inductors, capacitors and determine impedances;

9. Analyse a.c. circuits using phasor diagrams;

10. Determine power, Q-factor, and resonance in ac. circuits;

11. Explain the principle of the transformer and applications;

12. Distinguish between conductors, semiconductors, and insulators and explain crystal and band structure; identify semiconductor devices and explain their principle of operation;

14. Explain the current – voltage characteristics of semiconductor devices; and

15. Explain the function of semiconductor devices (diodes, transistors etc.)

**Course Contents**

D.C. Circuits. Sources of emf and current. Resistor combinations. Kirchhoff’s Laws. Network analysis and circuit theorems. Mesh currents method, Node-voltage, Thevenin and Norton theorem, superposition principle. A.C. Circuits. Sinusoidal wave-forms. RMS and peak values. Power. Resistance, inductance and capacitance in a.c. circuits. Impedance and admittance. Series and parallel RLC circuits. Q factor. Resonance. The transformer. Electronics: filters. Amplification and the transistor. Bipolar junction and field effect transistors. Equivalent circuits. Amplifiers. Feedback. Oscillators. Signal generators. Semiconductors (devices and characteristics). The pn-junction. Simple diodes. Photodiodes. LEDs.

BUK-**MTH304: Complex Analysis (2 Units C: LH 30)**

**Senate Approved Relevance**

Bayero University, Kano graduate students trained in Complex analysis are expected to acquire several benefits that include complex analytical skills that could help themsolved problems in physics and beyond. They will develop powerful skills for solving integrals, differentiation, limits, numerous applications in physics and engineering, such as in electromagnetic waves and fluid dynamics. They can also develop problem-solving skills and analytical thinking, which can be beneficial in other areas of physics, electronics and in other fields.

**Overview**

Overall, learning the content related to functions of a complex variable offers several benefits, including improved problem-solving skills, enhanced understanding of complex analysis, calculus, and physics, and developing analytical skills that can be applied in various fields of physics and electronics.

**Objectives**

1. Improved Problem-Solving Skills: The study of functions of a complex variable helps develop problem-solving skills, as it involves dealing with complex numbers and functions that can be challenging to manipulate. The techniques used in solving complex variable problems can also be applied to other mathematical areas, enhancing your overall mathematical problem-solving ability.
2. Understanding of Complex Analysis: Complex analysis is a branch of mathematics that studies complex functions and their properties. Learning the content related to functions of a complex variable will provide a solid foundation for understanding complex analysis and its applications in various fields, including physics, engineering, and finance.
3. Enhancing Understanding of Calculus: Functions of a complex variable involve concepts such as limits, derivatives, integrals, and sequences and series of functions, which are integral parts of calculus. By studying complex variables, you will gain a deeper understanding of these calculus concepts and their application.
4. Applications in Physics and Engineering: Complex variables and their functions have several applications in physics and engineering, including the study of electromagnetism, fluid dynamics, and signal processing. Understanding the concepts related to complex variables can help you solve problems related to these fields.
5. Developing Analytical Skills: The study of complex variables requires a high level of analytical skills, including the ability to manipulate complex numbers, understand mathematical proofs, and solve complex equations. These skills can be applied in various areas of life and can enhance your problem-solving ability in general.

**Learning Outcomes**

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

1. Define functions of complex variable;
2. Derive Cauchy-Riemann equations;
3. Discuss conformal mapping;
4. Solve some problems involving contour integrals, Power and Taylor series of function of a complex variable.

**Course Contents**

Functions of a complex variable. Limits and continuity of functions of a complex variable. Deriving the Cauchy-Riemann equations. Analytic functions. Bi-linear transformations, conformal mapping, contour integrals. Cauchy’s theorems and its main consequences, convergence of sequences and series of functions of a complex variable. Power series. Taylor series.

BUK-**PHY 318: Semiconductor Devices (3 Units C: 45)**

**Senate Approved Relevance**

Students who undergo training in the field of semiconductors at Bayero University stand to gain numerous advantages, such as acquiring a more profound comprehension of contemporary technology, opening career prospects, developing strong analytical skills, gaining research opportunities, and the capability to make contributions towards societal development.

**Overview**

The content of semiconductors includes a broad range of topics related to the physics, properties, and applications of semiconductor materials and devices. The course covers the different classes of semiconductors, including their band structure, equilibrium, doping, and statistics. It also focuses on carrier distribution, transport, and recombination, and the techniques used to model and analyze selected semiconductor devices, such as p-n junctions, bipolar transistors, field-effect transistors, and charge-coupled devices. Additionally, the course explores the optical properties of semiconductors, including light-emitting diodes and photo-detectors, as well as solar cells. The aim of this course is to provide students with a comprehensive understanding of the physics and applications of semiconductor devices, as well as the skills necessary to design, model, and analyze these devices in various industries.

Objectives

The objectives of studying semiconductor devices are to:

1. Understand the physical principles behind the operation of semiconductor devices, including their structure, properties, and behavior.
2. Learn the different types of semiconductor devices, their characteristics, and their applications in various industries.
3. Develop the skills and knowledge required to design, model, and analyze semiconductor devices, including their performance, reliability, and efficiency.
4. Study the latest advancements in semiconductor device technology and their potential impact on future applications.
5. Gain hands-on experience in designing, fabricating, and testing semiconductor devices, including the use of advanced simulation and modeling tools.
6. Learn how to integrate semiconductor devices into electronic systems, including the design of circuits and systems that utilize these devices.

**Learning Outcomes**

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

1. explain the type, functionality, and operation of semiconductor devices;
2. distinguish between conductors, semiconductors, and insulators;
3. describe the crystal structure of representative semiconductor diodes and amplifying
4. describe the operation of semiconducting devices in a circuit;
5. be familiar with semiconductor device packaging and symbol representations;
6. recognize the functional operation of diodes and amplifying semiconductor devices;
7. describe how to test semiconductor devices and evaluate their status;
8. describe forward and reverse bias characteristics of diodes;
9. explain voltage-current characteristics of semiconductor devices;
10. explain the physics and operation of the transistors;
11. describe metal - semiconductor junction characteristics;
12. explain the basics of FET’s and MOSFET’s structures; and
13. state the principle of operation of photonic devices.

**Course Contents**

Classes of semiconductor. The physics of semiconductors. Band structure of metals, semiconductors, and insulators. Semiconductor equilibrium. Doping and statistics. Carrier distribution, transport, and recombination. Carrier drift, diffusion, and conductivity. Hall effect. semiconductor growth. Semiconductor quantum structures. Modelling and application of selected semiconductor devices. P-n junction. Review of junction and bipolar transistor physics. Major emphasis on MOS devices including field effect transistors and charge coupled devices. Consideration of advanced bipolar structures. Schottky barrier devices. Optical properties of semiconductors (light emitting diodes and photo-detectors). Solar cells.

**BUK-PYE436: Quantum Electronics and Computing (2 Units E: LH 30)**

**Senate approved relevance**

The study of quantum mechanics and quantum electronics is becoming increasingly important in today's technology-driven world, making it highly relevant for Bayero University students pursuing a B.Sc. in physics with electronics. Graduates trained in this course are provided with unique opportunity to delve into the fundamental principles that underpin modern technology and contribute to the ongoing scientific advances in this field.

**Overview**

Quantum Electronics and Computing is an interdisciplinary undergraduate course that focuses on the principles of quantum mechanics and their application to the fields of electronics and computing. The course covers a wide range of topics, including quantum gates and circuits, quantum information theory, and quantum error correction. Students will also learn about the physical implementation of qubits, such as superconducting circuits and trapped ions. Overall, the course will provide students with a strong foundation in the principles of quantum mechanics and their applications to electronics and computing, preparing them for careers in quantum computing, electronics, and related fields, as well as further research in these areas.

**Objectives**

The objectives of studying Quantum electronics and computing undergraduate course include:

1. Understanding the fundamental principles of quantum mechanics and electronics and their applications in various fields.
2. Developing skills in designing, modeling, and analyzing quantum computing and electronics systems.
3. Gaining knowledge of quantum gates and circuits, quantum information theory, and quantum error correction.
4. Understanding the physical implementation of qubits, such as superconducting circuits and trapped ions.
5. Learning about quantum programming languages, quantum computing simulators and emulators, and quantum computing libraries and frameworks.
6. Gaining knowledge of quantum optics, single-photon sources, quantum sensors, and detectors.
7. Understanding the applications of quantum mechanics and electronics in various fields, such as cryptography, optimization, machine learning, chemistry, and material science.
8. Developing analytical and problem-solving skills necessary to tackle complex quantum computing and electronics problems.
9. Preparing students for careers in quantum computing, electronics, and related fields, as well as further research in these areas.

**Contents**

Introduction to Quantum Mechanics: Overview of Classical Mechanics, Key concepts of Quantum Mechanics,Wave-particle duality,Quantum states and measurements,Superposition and entanglement,Quantum gates and circuits. Quantum Information Theory:Classical vs Quantum Information,Quantum States and Operations,Quantum Measurements and Observables. Quantum Error Correction:Quantum Teleportation and Cryptography, Quantum,Computing Hardware, Quantum Bits and Qubits, Physical implementation of Qubits, Superconducting Circuits, Trapped IonsQuantum Dots, Topological Quantum Computing, Quantum, Computing Algorithms, Deutsch-JozsaAlgorithm, Simon's Algorithm

Grover's Search Algorithm, Shor's Factoring Algorithm, Quantum Machine Learning Algorithms, Quantum Electronics. Fundamentals of Quantum Electronics: Quantum Optics, Quantum Dots, Single-Photon Sources ,Quantum Sensors and Detectors, Quantum Computing Software and Tools, Quantum programming languages (Qiskit, Cirq), Quantum Computing Simulators and Emulators, Quantum Computing Libraries and Frameworks, Quantum Applications, Cryptography, Optimization, Machine Learning, Chemistry and Material Science, Quantum Simulation

**BUK-PYE432: Control Systems and Automation (2 Units: LH 30)**

**Senate approved relevance**

The study of Control Systems has numerous practical applications that are relevant to our lives in many ways. Control Systems are ubiquitous in modern technology and industry, and understanding their principles and design is crucial for many fields, including aerospace, automotive, manufacturing, robotics, and more. Control Systems are used to regulate the behavior of complex systems, from simple household appliances to large-scale industrial processes. For example, they can be used to regulate the temperature of an oven, the speed of a motor, or the stability of an aircraft. Control Systems also play a critical role in ensuring the safety and efficiency of many systems, such as power plants, transportation networks, and medical equipment. Studying Control Systems provides students with the knowledge and skills needed to design and optimize control systems, as well as to troubleshoot and repair them when necessary. This makes it a valuable and practical course of study for anyone interested in pursuing a career in engineering, technology, or related fields.

**Objectives**

The main objectives of studying Control Systems include:

1. Understanding the fundamental principles of Control Systems: Students will learn about the basic principles and concepts that underlie Control Systems, such as feedback control, stability, and response characteristics.
2. Analyzing and designing Control Systems: Students will learn how to analyze and design different types of Control Systems, including linear and nonlinear systems, time-invariant and time-varying systems, and discrete and continuous systems.
3. Developing skills in modeling and simulation: Students will develop skills in modeling physical systems and simulating their behavior under different control scenarios using mathematical tools such as differential equations and Laplace transforms.
4. Understanding the role of Control Systems in engineering applications: Students will learn about the various applications of Control Systems in engineering, including aerospace, automotive, manufacturing, robotics, and more.
5. Developing problem-solving skills: Students will develop problem-solving skills by working on real-world control problems and designing solutions using appropriate tools and techniques.

**Overview**

It covered topics such as modeling of dynamic systems, time response analysis, stability analysis, frequency response analysis, design of compensators, state-space representation and analysis, and digital control systems. The course also includes practical aspects such as the design and analysis of feedback control systems using MATLAB and Simulink. The relevance of the course was also discussed, including its importance in various fields such as aerospace, automotive, and manufacturing industries, as well as in the development of new technologies such as robotics and automation. The objectives of studying Control Systems were also highlighted, which include developing a deep understanding of the principles and concepts underlying control systems, as well as the ability to design, analyze and implement control systems to achieve desired performance and stability.

**Contents**

introduction to feedback control systems, modeling of dynamic systems, time-domain and frequency-domain analysis of control systems, control system design techniques, state-space analysis, digital control systems, nonlinear control systems, robust control systems, and control system applications in various fields. Students will learn about transfer functions, block diagrams, signal flow graphs, root locus technique, pole placement, PID controller design, controllability, observability, sampling and reconstruction of signals, uncertainty and sensitivity analysis, H-infinity control, μ-analysis, and more. Practical applications and simulations using software tools like MATLAB or LabVIEW may also be included. The course provides a strong foundation in Control Systems that prepares students for further study or careers in aerospace, automotive, manufacturing, robotics, and other related fields.

**BUK-PYE321: Introduction to Embedded System (2 Units C: LH 30)**

**Senate Approved Relevance**

Embedded Systems aims to equip graduate students with the necessary skills to question and think rationally about the use of electronic hardware and software as well as integrating them to tackle societal challenges and improve technology for a better quality of life. By exploring the operations of embedded systems and the underlying principles, graduates will gain a deeper understanding of how to reproduce and modify such devices, leading to the identification and development of new devices and applications. Through this course, Bayero University, Kano hopes to fulfill its mission and vision of producing graduates who can leverage embedded systems to address real-world problems and drive technological progress.

**Overview**

The course provides texture and flavour of physics in explaining the operation of variety of devices, objects and phenomenon that control or affect human activities. The course also provides a basis for understanding application areas and factors that dictates the modification of instruments we use in our daily life.

**Objectives**

The objectives of the course are to;

1. Explain the significance of physics as it affects the everyday life of people
2. State the underlying laws and principles in some activities, objects and devices used by people in Kano
3. Identify the structure and composition of objects/devices with a view to reproducing and adapting essential instruments for artisans in Kano
4. Develop capacity for innovation of artisans in Kano
5. Develop new technologies that have potential for economic development of people of Kano
6. Improve local technologies

**Learning outcome**

On successful completion of the course, students shall be able to:

1. Analyse and explain the basic hardware of embedded systems.

2. Familiarize the major architectures of embedded systems.

3. Identify the key building blocks of embedded solutions.

4. Describe the hardware and software architecture of processors used in embedded systems.

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; 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).

**BUK-PYE433: Data Communication and Networking (2 Units E: LH 30)**

**Senate Approved Relevance**

Data Communication and Networking course will provide BUK’s Physics with electronics students with a strong background knowledge and skills in data communication and networking. This is necessary knowledge to build their capacity for questioning and rational thinking, enabling them to utilize these acquired skills to address societal challenges and contribute to the technological improvement of life, aligning with the university's mission and vision. The course will enhance the students' understanding of digital communication infrastructure’s operations and principles, allowing them to reproduce, modify and develop new systems and network. Ultimately, the course will equip students with the necessary skills to contribute to the advancement of society through building efficient data communications network.

**Overview**

The course provides texture and flavours of digital communications and networks in explaining the operation of variety of data communication network, digital signal encoding and techniques for transmitting and receiving information in digital form. The course also provides a basis for understanding application of internetworks we use in our daily life.

**Learning Outcomes**

Upon the completion of this course, students should be able to:

1. Discuss the theoretical fundamentals of how the Internet works;

2. Explain the functionalities of networking;

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; 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.

**BUK-PYE434: Artificial Intelligence and Applications (2 Units, LH 30)**

**Senate Approved Relevance**

Bayero University students can gain a fundamental understanding of AI and its applications by studying intelligent agents, knowledge representation and reasoning, machine learning, pattern recognition, and practical applications of AI. They will learn different forms of logic to reason about knowledge, build systems that learn automatically from data, and recognize patterns in data using classification techniques such as nearest neighbor rule, Bayes classifier, support vector machine, and k-means clustering. Moreover, this content will provide insights into practical AI applications, including building chatbots, image recognition systems, recommendation systems, and more. By acquiring these skills, students can develop systems that reason about complex information and make decisions based on that information, thus contributing to the field of AI.

**Overview**

This content covers a broad range of topics related to Artificial Intelligence (AI) and its applications, including intelligent agents and applications of AI, knowledge representation and reasoning, machine learning, and pattern recognition. Specifically, it covers concepts such as propositional and first-order logic, inference in first-order logic, probabilistic reasoning, utility theory, hidden Markov models, Bayesian networks, supervised and unsupervised learning, decision trees, statistical learning models, and pattern recognition techniques such as nearest neighbor rule, Bayes classifier, support vector machine, and k-means clustering. This content aims to provide a comprehensive understanding of AI and equip learners with the knowledge and skills to build intelligent systems.

**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 *Engineering and Technology* **374** New

Analysis (PCA) and Linear Discriminant Analysis (LDA), Classification Techniques – Nearest Neighbour (NN) Rule, Bayes Classifier, Support Vector Machine (SVM), K – means clustering.

**BUK-PYE437: Digital Signal Processing (2 Units, LH 30)**

**Senate Approved Relevance**

Graduate students introduced to the field of Digital Signal Processing at Bayero University, Kano, are expected to develop questioning and rational thinking skills that will enable them to utilize signal processing to help improve technological advancements. The course will enhance their understanding of digital signals and the techniques used in processing them. This will contribute to fulfilling the BUK's mission and vision, which aims to enhance the quality of life through science and technology.

**Overview**

The course provides texture and flavour of Digital Signal Processing.

**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. The course will provide students with a solid foundation in DSP theory and its practical applications.

**BUK-PYE322: Industrial Electronics Design (2 Units E: LH 30)**

**Senate Approved Relevance**

Industrial Electronics Design course aimed atequiping BUK’s physics with electronics graduates with necessary skills and knowledge that would help in addressing societal challenges for technological advancement. The course will enhance the understanding of electronic systems used in modern industries,their operations, principles, andapplication in developing and modifying systems. Graduates will be able to identify new application areas and design new systems/devices to tackle specific industrial challenges, contributing significantly to the field of industrial electronics design.

**Overview**

The course provides introduction to Industrial Electronics Design. The course also provides a basis for understanding application areas and factors that dictates the modification of instruments we use in our daily life.

**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 systems.

**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.

**BUK-PYE431: Introduction to Nanoelectronics (2 Units; LH 30)**

**Senate Approved relevance**

The content offers a profound understanding of nanoscience and nanotechnology, two fast-growing fields with immense potential in various areas such as medicine, energy, and electronics. BUK students will gain knowledge on nanomaterials synthesis and characterization, as well as their unique properties at the nanoscale. This knowledge can be applied to advanced research and development of new nanomaterials and devices. The course also delves into nanoelectronics and nanophotonics, covering topics such as Ohm's law, MOSFETs, and carbon nanotubes. Ultimately, the course establishes a strong foundation for further study and research in nanoscience and nanotechnology, along with numerous career opportunities in industries that utilize these technologies.

**Overview**

The courseprovides students with knowledge and understanding of physical background and applications of nanoelectronics in the technological advancement of molecular biology, agriculture, and medicine etc.To present students with various aspects of active research on next-generation nanoscale materials and electronic devices.

**Objectives**

The objective so the course is;

1. To prepare students for the next generation of electronics and become familiar with the recent research being undertaken in nanoelectronics.
2. To identify the basic operation of the nanoelectronics devices, their basic principles and theory from atoms up, and their electrical characteristics.
3. To describe the merits, demerits, and challenges of some of the futuristic nanoelectronic devices and the challenges of scaling conventional MOSFETs and possible solutions.
4. To broaden students understanding of the fundamentals and design technologies and applications of nanoscale structures and nanodevices for the future applications.

**Learning Outcomes**

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

1. Clearly understand the distinction between the classical electronic device and the Nanoelectronics device
2. Understand the challenges of scaling conventional MOSFET and possible solutions
3. Understand electrons at the nanoscale, based on the important phenomena in wave-particle duality, wave functions, and Schrödinger’s equation.
4. Understand the concept of electronic properties of the material in low- dimensional structure (Nano dimension including energy band and New ohms law.
5. Understand the concept of carrier transport from diffusive to semi-classical to Ballistic transport.
6. Differentiate between Ballistic to bulk MOSFET and their limitations
7. Identify Nanowires; single and double gate MOSFET, and Carbon nanotubes.
8. Understand the possible fundamental limits to the computation of a given parameter or physical quantity for a Nanoelectronic device by applying appropriate equations or formulas.

**Course Content**

Introduction to nanoscience. Introduction to nanotechnology. Synthesis of nanomaterials. Characterization of nanomaterials. Properties of materials at the nanoscale. Advanced research in nanoscience and nanotechnology. Classes of nanomaterials. Natural nanomaterials and Artificial nanomaterials. Nanoelectronics and nanophotonic. Ohm's law in nanoelectronics MOSFET, Nano-MOSFET (Operation, Short Channel Effects, Limits on Subthreshold Swing and its Consequences, Challenges in Scaling), Introduction to Bulk MOSFET, Carbon Nanotubes, Nanowires, Single and Double Gate MOSFET.

**Reference Materials**

1. David J. Griffiths, “Introduction to Quantum Mechanics”
2. S. M. Sze, "Physics of Semiconductor Devices", John Wiley and Sons,
3. D. A. Neaman, "Semiconductor Physics and Devices"
4. S. Datta, "Quantum Transport: Atom to Transistor", Cambridge University Press, 2nd ed., 2005"
5. M. Lundstrom, J. Guo: Nanoscale Transistors
6. Resources at Nanohub (<https://nanohub.org/> )

**BUK-PYE435: Signals and Systems (2 units C: LH 30)**

**Senate Approved Relevance**

Signals and Systems course will enrich BUK graduate of Physics with electronicswithfundamental concepts and techniques in signal analysis, including orthogonal signal space, fourier series and transforms, Laplace and Z transforms, linear systems and filters, convolution and correlation of signals, and sampling theorem. Students who study this content will gain a deep understanding of these concepts and their applications in signal processing, as well as the ability to analyze and manipulate different types of signals using mathematical tools. They will also learn about the importance of bandwidth and frequency domain characteristics of signals, as well as techniques for sampling and reconstruction of signals. Overall, this knowledge will enable students to design and analyze complex signal processing systems and contribute to the development of advanced communication technologies.

**Overview**

Signals and Systems encounter extensively in our day-to-day lives, from making a phone call, listening to a song, editing photos, manipulating audio files, using speech recognition software’s like Siri and Google now, to taking EEGs, ECGs and X-Ray images. Each of these involves gathering, storing, transmitting, and processing information from the physical world.

This course will equip to deal with these tasks efficiently by learning the basic mathematical framework of signals and systems. Here we will explore the various properties of signals and systems, characterization of Linear Time Invariant Systems/ Time variant systems, convolution and Fourier Series and Transform, and also deal with the Sampling theorem, Z-Transform, Correlation and Laplace transform. Ideas introduced in this course will be useful in understanding further Electronic/ Electrical Engineering courses which deal with control systems, communication systems, digital signal processing, statistical signal analysis and digital message transmission. Further concepts such as signal sampling and aliasing are introduced. The theory is exemplified with processing of signals in MATLAB.

**Objectives**

1. To give the basics of Signals and Systems required for all Electronics related courses.
2. To understand the behavior of signal in time and frequency domain.
3. To understand the characteristics of LTI systems.
4. To give concepts of Signals and Systems and its analysis using different transform techniques.

**Learning Outcomes**

1. Differentiate various signal functions.
2. Represent any arbitrary signal in time and frequency domain.
3. Understand the characteristics of linear time invariant systems.
4. Analyze the signals with different transform technique.

**Course Contents**

Introduction to signals and systems; basic concepts and definitions, time and frequency domain representations, and classification of signals and systems.Signal Analysi; Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function. Fourier analysis; Fourier series, Fourier transform, frequency response, and applications. Fourier Transforms involving Impulse function and Signum function, Introduction to Hilbert Transform.The Laplace transform and its applications in system response analysis, transfer function, and stability analysis are then covered. Discrete-time signals and systems are introduced, including the discrete Fourier transform, FFT algorithm, and applications. The Z-transform and its properties, sampling and reconstruction of signals, and time and frequency analysis of linear time-invariant systems are covered.Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Relationship between Bandwidth and rise time, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution. State-space analysis and its advantages, controllability and observability, and stability analysis using eigenvalues are then discussed. Applications of signal and system theory in communication systems, control systems, audio and image processing, and biomedical signal analysis are introduced.Sampling Theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

**Minimum Academic Standard**

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
2. Signals, Systems & Communications - B.P. Lathi, 2013, BSP.
3. Signals and Systems – Simon Haykin and Van Veen, Wiley 2 Ed.,
4. Signals and Systems – A. Rama Krishna Rao, 2008, TMH
5. Fundamentals of Signals and Systems - Michel J. Robert, 2008, MGH International Edition.
6. Signals, Systems and Transforms -C.L.Philips, J.M.Parr and Eve A.Riskin, 3Ed. 2004, PE. 5. Signals and Systems – K. Deergha Rao, Birkhauser, 2018.

**BUK-PYE323: Power Electronics (2 Units: LH 30)**

**Senate Approved Relevance**

BUK vision is to train and build capacity of graduates with exceptional skills in Power Electronics that possess the ability for questioning and rational thinking, enabling them to apply modern power electronics techniques to address societal challenges and improve the quality of life. This is aligned with the BUK's mission and vision. The course aims to expand the graduates' knowledge of power electronics converter operations, allowing them to reproduce, modify and develop new power devices and explore new application areas. Ultimately, this will equip students with the necessary skills to contribute to the technological advancement of society.

**Overview**

The course provides an overview of the art of Power Electronics. The course also provides a basis for understanding application areas and factors that dictates the modification of power devices we use in our daily life.

**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.** Understand the linear and switched mode connverters and their several control methods;

**4.** Be able to explain understand the concept of State Space Analysis;

**5**. Comprehend the operation principles for several thyristors-based rectifiers; quantify the current harmonics and the average power drawn by a rectifier

**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).

# **BUK-PYE 430: Communications Systems and Principles (3 Units C: LH45)**

**Senate-approved Relevance**

The course "**Communications Systems and Principles**" is vital and highly relevant to the modern world as the Information and communication systems play a vital role in our daily lives. In a world where people are more connected than ever before, the need for skilled professionals who can design and manage telecommunication systems is increasing and has become indispensable. BUK recognizes the importance of the telecommunication industry and has introduced this course to prepare students to become experts in this field.

**Overview**

The course "Communications Systems and Principles" provides students with a basic understanding of telecommunication systems, components, andoperation. The course covers the fundamentals of telecommunication systems, Analog and digital systems, data communication networks, transmission systems, and digital communication.

Additionally, the course will introduce the latest technologies in telecommunication, such as 5G networks and beyond, IoT, and Cloud computing. The course will include lectures, laboratory sessions, and assignments to provide students with hands-on experience in the field. Students will be required to complete a project that involves the design of a basic telecommunication system.

**Objectives**

The main objectives of this course are to provide students with:

1. describe the basis of telecommunication systems
2. describe the basis of telecommunication components.
3. explain the concepts and principles of data communication
4. describe digital communication and transmission systems
5. state the technologies in the telecommunication industry

**Learning Outcomes**

Upon successful completion of this course, students should be able to:

1. state at least three basic concepts and principles of telecommunication systems
2. describe the various types of signals and waveforms
3. analyse the components and design of data communication systems
4. evaluate transmission systems and digital communication.
5. identify the latest technologies in the telecommunication industry

**Course Contents**

Taxonomies of telecom systems. Electromagnetic spectrum. Signal waveforms. 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. Analog Modulation Techniques (AM, FM, and PM). Transmission of signals through guided and unguided media; copper pairs, coaxial, waveguides, optical fibres and wireless radio. Introduction to Microwave Communication. 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. Components of Telecommunication Systems.Digital Communication Systems. Data Communication. Transmission Systems. Introduction to 5G Networks. Internet of Things (IoT) and Cloud Computing in Telecommunication. Satellite communication Systems.

## **Minimum Academic Standards**