**Bayero University, Kano (BUK)**

**Engineering**

**Chemical and Petroleum Engineering**

**B.Eng Petroleum Engineering Programme**

**30% Additional Courses to CCMAS**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 100 LEVEL | | | | | | | |
| Course Code | Course Title | Pre-req | | Units | Status | LH | PH |
| BUK-PHY103 | General Physics III |  | | 2 | C | 30 |  |
| BUK-PHY104 | General Physics IV |  | | 2 | C | 30 |  |
|  | Total |  | | 4 |  |  |  |
| 200 LEVEL | | | | | | | |
| BUK-GET208 | Strength of Materials |  | 3 | | C | 45 |  |
|  | Total |  | 3 | |  |  |  |
| 300 LEVEL | | | | | | | |
| BUK-TCH 301 | Transfer Processes I |  | 3 | | C | 15 | TUT 15 |
| BUK-PEE315 | Numerical Methods |  | 3 | |  |  |  |
|  | Statistics for Petroleum Engineers |  | 2 | |  |  |  |
|  | Total |  | 8 | |  |  |  |
| 400 LEVEL | | | | | | | |
| BUK-PEE 403 | Drilling Technology II | PEE 304 | 2 | | C | 30 |  |
| BUK-PEE 409 | Production Engineering II | PEE 309 | 3 | | C | 30 |  |
| BUK-PEE 411 | Well Completion |  | 2 | | C | 30 |  |
| BUK-PEE 413 | Well Testing | PEE 310, PEE 306 | 3 | | C | 30 | 45 |
| BUK-PEE 407 | Natural Gas Processing |  | 2 | | C | 30 |  |
| BUK-PEE 417 | Transfer Processes II |  | 3 | | C | 45 |  |
|  | Total |  | 15 | |  |  |  |
|  | | | | | | | |
| 500 LEVEL | | | | | | | |
| BUK-PEE 501 | Petroleum Economics |  | 3 | | C | 45 |  |
| BUK-PEE 503 | Reservoir Simulation |  | 3 | | C |  |  |
| BUK-PEE 506 | Offshore Operations |  | 3 | | C | 45 |  |
| BUK-PEE 512 | Petroleum Products, Transportation and Storage |  | 2 | | C | 30 |  |
| BUK-PEE 514 | Enhanced Oil Recovery |  | 3 | | C | 45 |  |
| BUK-PEE 509 | Integrated Asset Development (Capstone Design) |  | 3 | | C | 15 | 90 |
| BUK-TCH542 | Process Safety and Loss Prevention in Industries |  | 2 | | C | 30 |  |
| BUK-TCH544 | Environmental Pollution and Control |  | 2 | | C | 30 |  |
|  | Elective |  | 4 | | E | 60 |  |
|  | Total |  | 25 | |  |  |  |
|  |  |  |  | |  |  |  |
|  | Total core units developed: 55 |  |  | |  |  |  |
|  | Total elective units developed: 4 |  |  | |  |  |  |
|  | Total units developed: 59 |  |  | |  |  |  |

**PHY 103: General Physics III (Behaviour of Matter) (2 Units C: LH 30)**

**Senate approved relevance**

Physics just as mathematics are the bedrock of any engineering course. Knowledge of Physics is essential skill required for any engineering student as it provides the basis on which the students can build their engineering skills on. Thus, it is fundamentally important that the students are equipped with the knowledge Behaviour of Matter. This is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

Behaviour of matter is a vital course that 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 that they will encounter during their training.

This course is designed to introduce students to the concept of laws of thermodynamics, thermal conductivity, and kinetic theory of gases. The use of Bernoulli’s equation to solve incompressible fluid flow problems will also be covered. 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

**Course Objectives**

The objectives of the course are to:

1. introduce the concepts of heat and temperature and relate the temperature scales;
2. explain the various gas laws, the general gas equation and its application
3. explain thermal conductivity
4. explain First Law of thermodynamics and Thermodynamic processes
5. explain Second law of thermodynamics
6. explain Zeroth law of thermodynamics.
7. know the Kinetic theory of gases and understand molecular collisions and mean free path.
8. explain the concepts of elasticity including Hooke's law, Young's modulus, shear and bulk moduli)
9. explain Archimedes' principles
10. use Bernoulli’s equation to solve incompressible fluid flow problems
11. explain the concepts of surface tension including adhesion, cohesion, viscosity etc.

**Learning Outcomes**

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

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

**Course Contents**

Heat and temperature (temperature scales). Gas laws. General gas equation. Thermal conductivity. First Law of thermodynamics (heat, work and internal energy, reversibility). Thermodynamic processes (adiabatic, isothermal, isobaric). Second law of thermodynamics (heat engines and entropy). Zeroth law of thermodynamics. Kinetic theory of gases. Molecular collisions and mean free path. Elasticity (Hooke's law, Young's, shear and bulk moduli). Hydrostatics (Pressure, buoyancy, Archimedes' principles). Bernoulli’s equation and incompressible fluid flow. Surface tension (adhesion, cohesion, viscosity, capillarity, drops and bubbles).

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PHY 104: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)**

**Senate Approved Relevance**

Physics just as mathematics, is the bedrock of any engineering course. Knowledge of Physics is essential skill required for any engineering student as it provides the basis on which the students can build their engineering skills on. Thus, it is fundamentally important that the students are equipped with the knowledge of vibration, waves and optics. This is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

Vibration, waves and optics is a vital course that 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 that they will encounter during their training.

This course is designed to introduce students to the concept of optics and waves as well as the application in instrumentation and interpretation of results of analysis. 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.

**Course Objectives**

The objectives of the course are to:

1. understand simple harmonic motion
2. understand of the distinction between Transverse and Longitudinal Waves and predict which will be supported in various media.
3. relate period, frequency, wavelength, and velocity for harmonic waves.
4. apply the concept of linear superposition to standing waves and mechanical resonance.
5. understand optics and wave properties of light

**Learning Outcomes**

On completion, the students should be able to;

1. describe and quantitatively analyse the behaviour of vibrating systems and wave energy;
2. explain the propagation and properties of waves in sound and light;
3. identify and apply the wave equations;
4. explain geometrical optics and principles of optical instruments.

**Course Contents**

Simple harmonic motion (SHM): energy in a vibrating system, Damped SHM, Q values and power response curves, Forced SHM, resonance and transients, Coupled SHM. Normal modes. Waves: types and properties of waves as applied to sound; Transverse and Longitudinal waves; Superposition, interference, diffraction, dispersion, polarization; Waves at interfaces; Energy and power of waves, the 1-D wave equation, 2-D and 3-D wave equations, wave energy and power, phase and group velocities, echo, beats, the Doppler effect, Propagation of sound in gases, solids and liquids and their properties.

Optics: nature and propagation of light; reflection, refraction, and internal reflection, dispersion, scattering of light, reflection and refraction at plane and spherical surfaces, thin lenses and optical instruments; wave nature of light; Huygens’s principle, interference and diffraction.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

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

**Senate approved relevance**

Knowledge of strength of materials is greatly required in engineering projects, design of bridges, girders, structures, buildings and machine developments. The course will give students a clear understanding of the principles underlying engineering design and guide them in the design procedures and processes that will ensure safe designs that could stand the test of time.

**Overview**

Strength of materials is a course that introduces the engineering students to the study of the effect of external forces on engineering materials and the ability of the materials to resist failure. The fundamental knowledge in elementary applied mechanics and calculus is required for quick and better understanding of the course.

The course will introduce materials classification, types of stress and the stress strain relationship. Effect of shearing forces and bending moments on beams will be considered. The pure bending and deflection of different classes of beams shall be considered. The causes of failure, types of failure and failure analysis will be considered as well.

**Course Objectives**

The objectives of the course are to:

1. understand the concept of structural systems
2. understand stress-strain relationship of structural system
3. introduce the concept of failure in a structural system.
4. understand the concept of beams, shear forces and bending moment
5. discuss the application of Mohr’s in the evaluation of normal and shear stresses of a multidimensional stress system

**Learning Outcomes**

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

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

**Course Contents**

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

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK TCH 301: Transfer Processes I (3 Units C: LH 15; PH 45)**

**Senate-Approved Relevance**

Training of high-quality petroleum engineering graduates that will meet the demand of petroleum industry entails development of skills in different transfer processes as exemplified in many transport phenomena operation, especially heat transport.

**Overview**

heat and mass transfer are a branch of the Transport phenomena. This course is designed to teach students the importance of heat and mass transfer. This course includes studying the principles of heat and transfer and general molecular transport equation.

Students are helped to appreciate forms of heat and mass transfer, Reynolds’ analogy and heat and transfer coefficients. They are also introduced to types and design of heat exchangers.

**Learning Outcomes**

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

1. derive the heat diffusion equation and use it to predict temperature profiles across solid bodies transferring heat by conduction;

2. derive equations of heat transfer by convection and use them to predict the rate of heat loss under steady state natural and forced convection;

3. derive the equations of heat loss by radiation, and use them to predict the rate of heat loss under steady state conditions;

4. perform a procedural design of a heat exchanger for defined process requirements;

5. derive equations of mass transfer by molecular diffusion and use these to predict the flow rates and composition of output streams from a mass transfer operation under steady state conditions;

6. determine the performance and size of a given heat exchanger using different methods; and

7. perform pressure drop calculations and procedural design of different heat exchangers according to defined process requirements.

**Course Contents**

Steady State Conduction. Forced and Natural Convection. Reynolds' Analogy. Heat Transfer Film Coefficient Correlations. LMTD Heat Transfer Design. Fouling Factors. Radiation; Blackbody Radiation, Emission from Real Surfaces. Kirchoff’s Law. Unsteady-State Conduction. 2-D Conduction. Fundamentals of Mass Transfer. Similarity of Momentum, Heat and Mass Transfer. Convective Mass Transfer. General, Molecular and Turbulent Diffusion Equations. Fick’s Law for Diffusion. Molecular Diffusion in Gases, Liquids and Solids. Diffusion Coefficients in Gases. Liquids. Shell and Tube Heat Exchangers. LMTD Correction Factors. Heat Transfer and Pressure Drop Correlations. HX Design and Performance (Kern’s and NTU Methods for Multipass and Cross-Flow HX). Compact Heat Exchangers. Plate Heat Exchangers. Operating Principles, Series and Parallel Combination, Use and Limitations. Comparison with Shell and Tube Heat Exchangers.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 315: Numerical Methods (3 Units C: LH 45)**

**Senate approved relevance**

**Overview**

Numerical methods are techniques by which the mathematical problems involved with engineering analysis that cannot be readily or possibly solved by analytical methods are solved numerically. In this course, students will learn the use of some of these numerical methods such as Newton-Raphson method, bisection method etc.

The students will also be introduced to the use of mathematical packages such as MATLAB or Mathematica that will enable engineers to solve many mathematical problems.

**Course Objectives**

The objectives of the course are to:

1. understand the alternative ways of using numerical methods to solve nonlinear equations, perform integrations, and solve differential equations;
2. Learn the principles of various numerical techniques for solving nonlinear equations performing integrations, and solving differential equations by the Runge-Kutta methods.
3. Learn the fact that numerical methods offer approximate but credible accurate solutions to the problems that are not readily or possibly solved by closed-form solution methods.
4. Learn the fact that numerical solutions are available to the users only at the preset solution points, and the accuracy of the solution is largely depending on the size of the increments of the variable selected for the solutions.
5. Become familiar with the value of commercially available numerical solution software packages such as Mathematica and MATLAB

**Learning Outcomes**

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

1. Solve algebraic and transcendental equations using bracketing methods (Bisection and Reguli-Falsi)
2. Solve algebraic and transcendental equations using open methods (Secant, Fixed point iteration and Newton-Raphson)
3. Solve numerical differentiation problems and carry out error analysis
4. Solve numerical integration problems
5. Carry out curve fitting and interpolation
6. numerically solve differential equations using MATLAB and other emerging applications

**Course content**

Solution of nonlinear polynomial and transcendental equations using numerical methods; numerical differentiation and integration; root finding; numerical solution of differential equations; curve fitting and interpolation; Use computer application (MATLAB) to solve mathematical problems.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 316: Statistics for Petroleum Engineers (2 Units C: LH 30)**

**Senate-approved relevance**

The relevance of the course will be seen in students from BUK being able to effectively apply the knowledge and skills of statistics to analyse data generated from oil and gas industry, which would help in improving the productivity of its facilities. This is one of the important requirements of a petroleum engineering graduate in the petroleum industry. Therefore, this is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

Petroleum engineers must have an appreciation of the accuracy and reliability of measurements. This course provides a broad introductory knowledge of statistical techniques used in data analysis.

The course seeks to link the measurement of various quantities with statistics to enable the analysis of the accuracy of the measurements. Students to have weekly or fortnightly computer laboratory-based assignments.

**Course Objective**

The objectives of the course are to:

1. describe statistical inference

2. conduct experimental design

3. analyze real data using statistical software

4. Evaluate statistical error of analyzed data.

**Learning Outcomes**

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

1. construct appropriate graphical displays of data and understand the role of such displays in data analysis;

2. perform statistical inference tasks using software and understand the calculations involved in such tasks and be aware of assumptions necessary for the validity of results;

3. use and interpret statistical software package to analyse industry data;

4. make appropriate conclusions based on experimental results;

5. plan and execute an experimental program to determine the performance of an oil production system;

6. evaluate the accuracy of the measurements taken; and

7. communicate the results of the investigation in a number of ways.

**Course Contents**

Statistical inference intervals. Tests hypothesis and significance. Regression and correlation. Error. Design of experiment. ANOVA. Introduction to big data analytics. cloud computing applications

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 403: Drilling Technology ll (3 Units, Core: L= 45, P=0)**

**Senate-approved relevance**

The relevance of the course will be seen in students from BUK being able to effectively apply the knowledge and skills of drilling technology in the oil and gas industry. This is one of the important requirements of a petroleum engineering graduate in the petroleum industry. Therefore, this is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

This course is a continuation from drilling technology l. It will teach students the various facet of casing design, cementing programming, well control and the drilling of directional wells.

The module will prepare students towards a career as a drilling engineer in the oil and gas industry, being able to carry out drilling operations. Prior knowledge of Drilling Technology I is required for this course.

**Course Objectives**

The objectives of the course are to:

1. understand the concept of casing, types of casing and appreciate the design of casing programs
2. understand the various forms of well control and the mechanism for each type of well control
3. describe kick, causes of kick, signs of kick and the various methods for kick control (driller’s method and engineer’s method)
4. understand subsurface formation pressures and mud hydrostatic pressure
5. explain the procedures for shutting in the well
6. understand the concept of cementing and the purpose of cementing
7. describe the process of cementing and cement evaluation.
8. explain fishing and fishing methods
9. understand the concept of directional drilling, the equipment used for directional drilling and planning a directional drilling program.

**Learning Outcomes**

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

1. Explain the concept of casing, list 5 types of casing with their properties, and design a casing program (axial tension, burst pressure, and collapse pressure)
2. explain the 3 forms of well control and describe their mechanism control
3. describe kick; explain the 5 causes of kick, explain 10 signs of kick, and explain the procedures for kick control (driller’s method and engineer’s method)
4. distinguish between subsurface formation pressures and mud hydrostatic pressure
5. describe the procedures for shutting in the well
6. explain the concept of cementing and state at least 5 reasons for cementing
7. describe the process of cementing and sate how a cement job is evaluated
8. explain fishing and fishing methods
9. explain directional drilling and state 5 reasons for directional drilling, list the equipment used for directional drilling
10. identify the different trajectories for directional drilling and design a directional drilling program.

**Course Contents**

Casing, Types of casing, Purpose of casing, Casing Design: Mechanical properties–tension, collapse and burst; designing a casing string. Well Control, Pressure Control and Blowout Prevention: The need to control pressure. Well control equipment; BOP valves; stack, choke line and choke manifold; choice of BOP system. Kick, causes of kick, signs of kick, control of kick; subsurface formation pressures and mud hydrostatic pressure; data for executing kick control; Procedure for shutting in the well, methods of circulating out a kick–Balanced Bottom Hole Pressure method (BBHP), driller’s method and engineers method.

Cementing: Purpose of cementing, Slurry design, Properties of cement, Cement additives, Equipment for cementing; hole conditions; volume calculations, Cementing program, cement evaluation. Fishing: Fishing tools; objects lost in the hole; fishing methods. Directional Drilling. Planning well trajectory, deviation measurements. Offshore Drilling: Under water BOP stack, marine risers, underwater wellhead, floater stability.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 409: Production Engineering II (3 unit; core; L=45)**

**Senate-approved relevance**

Production engineering is a bedrock of petroleum engineering. Production engineering exposes students to the skills and knowledge necessary to bring petroleum to the surface cost effectively and safely. Production engineering knowledge is a basic requirement of any petroleum engineering graduate. Therefore, Therefore, this is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

The course gives the student a good grasp on the design of various separators that are employed to separate the crude from different components. It predisposes the students to challenges and problems encountered during the separation process and offers ways of mitigating the encountered problems and challenges

**Learning objectives**

The objectives of the course are to:

1. understand the concept of fluid separation using different types of separators
2. learn the problems and treatment process associated with fluid separation such as emulsion, foaming and dehydration
3. design separator and compressor and to understand the thermodynamics of compressor and compressor efficiency

**Learning Outcomes**

On completion of the course, student should be able to:

1. apply the concept of fluid separation using different types of separators
2. explain the problem with fluid separation: emulsion, foaming, dehydration, and treatment process
3. undertake separator and compressor design and explain the thermodynamics of compressors and compressors efficiency

**Course contents**

Surface equipment: Gathering systems, Design and Testing of flow lines, service and cleaning of systems. Phase separation: separation process, separators and components, design and construction of separators, dehydration, emulsion problem, and treatment. Dew point depression, absorption and adsorption.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 411: Well completion, (2 unit; core; L=30)**

**Senate-approved Relevance**

Another bedrock of petroleum engineering, well completion exposes students to the requisite knowledge to safely and cost-effectively prepare a well for production after drilling. A thorough understanding of this course put our graduate well above others. Therefore, Therefore, this is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

The students are introduced to sub-surface operations needed to prepare the well for production after being drilled and cased. Knowledge imparted to student includes well completion design based upon reservoir, mechanical and economic considerations. The various working of the production system, comprising of bottom hole tubing, choke and surface facilities are operations predisposed to students. Sub-surface production control, completion and work over fluids design are other areas that form part of the course

**Learning objectives**

The objectives of the course are to:

1. understand the concept, approach, and practice of preparing the well for production through well completion
2. provide the knowledge of well completion operations
3. provide knowledge of sub-surface equipment
4. planning and design of tubing string after testing of the hydrocarbon zones available
5. learn coil tubing unit (CTU) operation whenever rig less operation are required to be conducted

**Learning outcomes**

On completion of the course, student should be able to:

1. prepare the well efficiently for production through well completion
2. describe well completion operations
3. explain various sub-surface equipment including packers, safety valves and sliding sleeves
4. design tubing string to produce the well after testing of available hydrocarbon zone
5. plan for suitable safety valves in sub-surface as well as on well head to be used for safe operations of high pressure and temperature wells
6. perform coil tubing unit operation (CTU) whenever rig less operation are required to be conducted

**Course contents:**

Types of wells. Types and function of completion. Completion equipment. Data acquisition in wells. Intelligent completion equipment. Types of perforation. Tubing string design. Work-over equipment.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 413 Well Testing, (3 Units; Core; L = 30; P = 15)**

**Senate-approved relevance**

Well testing is one of the most valuable tools used by reservoir engineers. It is routinely used to evaluate well and field performance, diagnose reservoir characteristics, integrate test results with other studies, plan for future development and perform the overall management of the reservoir. Well tests are performed throughout the life cycle of a reservoir to accomplish a large number of important objectives and gather valuable information such as formation transmissibility and storativity, average reservoir pressure, near wellbore phenomena including skin effects etc.

**Overview**

This course introduces the fundamentals of well testing to the students and provides essential skills that are vitally important in the industry. Important topics such as well test interpretation, well test design, well testing methods etc. will be discussed.

The importance of the course lies in providing hands-on skills to the students and introducing industry software used in well test analysis to the students.

**Learning objectives**

The objectives of the course are to:

1. introduce the students to the concept of well test analysis
2. identify the objectives of well testing
3. identify the various flow regimes and explain the behavior of bounded and unbounded reservoirs
4. explain the various well testing methods and their importance
5. identify the critical reservoir and well data that can be obtained from well testing
6. carry out well test design
7. interpret well test data
8. learn how to use commercial well testing software

**Learning Outcomes**

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

1. know the objectives of well testing
2. select appropriate well testing methods and interpret tests’ data
3. describe the fundamental principle behind all types of well tests
4. calculate the reservoir and well properties that can be obtained from various types of tests
5. analyse data and assess strengths and limitations of well test interpretation
6. interpret well test results
7. derive long term production forecast from a short test

**Course Contents**

Well test objectives and concept. Fluid flow equation and fundamental solution. Analysis of well performance under varied reservoir conditions including evaluation of unsteady, pseudo-steady and steady state flow. Flow regimes and bounded reservoir behavior. Well testing methods. Water coning and effects of partial penetration. Well test interpretation.Well test design, equipment and operations. Review of well testing software. Practical use of well testing software.

**Prerequisites: PEE 310, PEE 306**

**Minimum Academic Standards**

Reservoir engineering laboratory equipped with state-of-the-art well testing software such as Sapphire and PIE Well Test software.

**BUK-PEE 417 Transfer Processes II (2 Units; Core; L = 30; P =0)**

**Senate-approved relevance**

Training of high-quality petroleum engineering graduates that will meet the demand of process industries entails of development of skills in different transfer processes as exemplified in many transports phenomena operation, especially momentum transport. The operation of many process industries requires good skill in the understanding of the design of many equipment where different transfers of materials are taking place to get the final output which solves engineering problems.

**Overview**

The course which is designed as a continuation of transfer I which focus more on heat and mass transfer processes especially heat exchangers was designed to create in the undergraduate students additional critical thinking abilities in resolving problems in other transfer processes such as momentum transfer and other associated transport phenomena techniques.

In this course, students will be taught the relationship between the three transport mechanisms. They will be introduced to the concept of viscosity and its application.

**Objectives**

The objectives of the course are to:

1. define the basic laws of momentum, mass and energy transfer;
2. describe the relationship between the three transfer laws;
3. describe the transfer coefficients for each of the different transport mechanisms;
4. define viscosity as a mean of the mechanism of momentum transfer;
5. describe the Newton law of viscosity with its generalization to understand the pressure and temperature dependence of viscosity, molecular theory of the viscosity of gases at low density and convective momentum transport;
6. describe the shell momentum balances and velocity distributions in laminar flow;
7. describe the relevance of dimensionless numbers in transport operations.

**Learning outcomes**

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

1. state the mathematical representations of the three (3) laws of transfer;
2. describe at least two (2) momentum transfer problems in their mathematical forms and solve them;
3. evaluate the transfer coefficient(s) from the equations for design purposes;
4. construct one (1) equation each for viscosity measurement using three (3) different states of matter;
5. list two (2) factors affecting velocity distributions;
6. list at least four (4) step used in the derivation of the equation of state and their application in flow calculation;
7. describe three (3) dimensionless numbers and their application in transport processes;

**Course contents**

Basic Laws of mass momentum and energy transfer process and their relationship. Measurement calculations and prediction of transport coefficients. Viscosity and the Mechanisms of Momentum.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 503: Reservoir Simulation (3 Units; Core; L = 30; P = 45)**

**Senate-approved relevance**

Training of high-quality petroleum/reservoir engineering graduates that will meet the demand of petroleum industries entails development of skills in reservoir simulation. The development and performance of any reservoir requires good understanding of the principles of reservoir simulation as it plays an essential role in any field development project. Thus, reservoir simulation is an essential tool for any reservoir/petroleum engineer to have in his toolkit.

**Overview**

The course introduces the student to the basic theory and practices in reservoir simulation. The formulation of equations governing single phase and multi-phase flow in porous media are discussed. The use of finite difference methods to solve ordinary and partial differential equations are then presented followed by discussion of various techniques to solve systems of linear equations. Finally the concepts presented are demonstrated through applications using a black oil simulator.

**Objectives**

The objectives of the course are to:

1. provide an overview of reservoir simulation software to conceptualize the complex nature of reservoirs
2. understand the importance and the fundamental concepts of reservoir simulation
3. use a reservoir simulation package to solve complex fluid flow problems
4. conduct a reservoir simulation study

**Learning Outcomes**

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

1. know the objectives of reservoir simulation
2. have basic knowledge of reservoir simulation
3. explain the physical laws that govern fluid flow in porous media
4. describe at least 5 commercial reservoir simulators
5. use commercial reservoir simulator to study reservoir performance in response to different development strategies
6. develop some experience with history-matching a reservoir simulation model
7. apply finite difference techniques to solve differential equations
8. conduct a reservoir simulation project and suggest development plans for the reservoir
9. interpret reservoir simulation results

**Course Contents**

Concepts of Simulation: purpose of reservoir simulation. Review of Darcy’s law, continuity equation, single phase flow equations, multiphase flow equations. Reservoir simulation equations. Finite – difference model solution of the simulator equations. Review of reservoir simulation software. Practical applications of simulator. Data preparation (Preparation and Input, initialization, history matching and performance predictions). Solution of production and reservoir engineering problems using state-of-the-art commercial reservoir simulation software, using data commonly available in industry; emphasis on reservoir description, reservoir model design and calibration, production forecasting and optimization, economic analysis, decision making under uncertainty and sensitivity analysis (practical use of reservoir simulator).

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-TCH 542: Process Safety and Loss Prevention in Industries (2 Units C: LH= 30)**

**Senate-approved relevance**

Topics on Safety and Loss Prevention in Chemical Process industries are concerned primarily with the identification of potential hazards and hazardous conditions associated with the processes and equipment utilized in chemical process industries. It includes methods of predicting the possible severity of the associated hazards and preventing, controlling or mitigating them. The course will prepare the would-be chemical engineers with techniques for performing process hazard analysis, risk assessment, and accident investigations chemical processing industry.

**Course Overview**

This course covers the principles and knowledge of process safety and loss prevention in the industrial setting. It acquaint would be chemical engineering graduates with advanced safety matters such as process safety management systems, hazard identification, risk assessment, risk management, hazard analysis, and safety audit. This will afford them the skill to identify potential hazards and hazardous conditions associated with the processes and equipment involved in the chemical process industries.

It describes the elements of a modern approach to process safety. It provides the basis for how process safety should be approached and implemented across the lifecycle of a project. The interaction between process design and hazard identification is explored. Some hazard study techniques are introduced and the concepts underlying risk and risk criteria are analysed.

**Objectives**

The objectives of the course are to:

1. identify the potential hazards in chemical process industries;
2. review the major fatal accident in the chemical industries;
3. discuss key factors influencing process safety;
4. evaluate the safety performance of a chemical plant using relevant techniques;
5. analyse and evaluate the consequences of safety failure on immediate surroundings and economy;
6. evaluate ways of mitigating fire and explosion in chemical plants;
7. evaluate the adequateness of the layer of protection and select suitable safety features;
8. conduct hazard control plans in chemical industries;
9. describe the common legislation in managing process safety.

**Learning Outcomes**

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

1. list four (4) potential hazards in chemical process industries;
2. describe five (5) records of a fatal accident in the chemical industries;
3. enumerate the six (6) factors affecting process safety;
4. evaluate the safety performance of a chemical plant using two (2) techniques;
5. list four (4) consequences of safety failure on immediate surroundings and economy;
6. list five (5) ways of mitigating fire and explosion in chemical plants;
7. apply a layer of protection analysis for quantitative analysis and assessment of risk to at least one(1) scenario;
8. identify and evaluate at least two (2) options for controlling hazards using the hierarchy of control
9. mention at least 4 common legislations in managing process safety

**Course Content**

Review of some major accidents in process industries. Hazard Identification. Hazard types. Assessment and Control. Introduction to Process. Safety Engineering. Loss Prevention. Toxic Materials. Dose and Response Curves. Threshold Limit Values and Permissible Exposure Levels.

MSDS's. Monitoring of Volatile Toxicants. Toxic Release and Dispersion Models -Pasquill-Gifford Plume and Puff Models. Fires and Explosions: Flammability of liquids and vapours. Explosions - Detonations and Deflagrations. Fire and Explosion Protection and Prevention-Inerting, Purging Static Electricity. Explosion Proof. Equipment Ventilation. Sprinklers. Hazard Identification Checklists. DOW.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-TCH544: Environmental Pollution and Control (2 Units; C: LH = 30)**

**Senate-approved relevance**

For every chemical process, pollution of the environment is almost inevitable though the gravity of pollution may differ based on the mode of operation and control of produced pollutants. To have graduates that will know appropriate pollution control to reduce loss of biodiversity, global warming and be able to project and understand the impact of chemical processes on the environment, in general, will emerge. The role of regulatory agencies in ensuring environmental pollution is controlled.

**Overview**

Environmental pollution control promotes the efficient use of raw materials, equipment and water and this will eventually lead to a safer environment and promotes the health of workers and residents in the environment. The importance of the course lies in preparing an Environmental Impact Assessment (EIA) and Environmental audit that will be used as predictive tools that can be employed for the siting of industrial and residential layouts.

**Objectives**

The objectives of the course are to:

1. identify and discuss sources of environmental pollution;
2. discuss environmental pollutants in (air, water, and land);
3. identify and discuss methods of remediating identified pollutants;
4. identify and discuss the functions of environmental regulatory bodies in general;
5. state functions of regulatory bodies in Nigeria;
6. discuss the dispersion of pollutants in water;
7. discuss principles and practices related to engineering control of emissions from different sources;

**Learning Outcomes**

On completion of the course, students should be able to:

1. identify 3 sources of pollution each for air, water and land;
2. list 3 pollutants each for air, water and land and suggest remediation for each;
3. describe 3 functions of each of any 2 regulatory bodies in Nigeria in environmental pollution control
4. describe at least 2 roles of regulatory bodies in environmental pollution control;
5. develop at least 1 mathematical model for atmospheric pollutant dispersal;
6. describe the analysis of dispersed pollutants in water
7. identify the theory and any 2 principles related to engineering control of particulate and gaseous emissions from different sources.

**Course Content**

Sources of water. Introduction to water pollution. Types of water pollution. Sources of water pollution. Analysis of dispersed pollutants in water. Effects of water pollutants on the environment. Streams and effluent standards. Water treatment processes for domestic uses. Water treatment for industrial uses. Introduction to air pollution. Types of air pollution. Theory, principles and practices related to engineering control of particulate and gaseous emissions from natural, industrial, agricultural, commercial and municipal sources of atmospheric pollution. Effect of atmospheric pollution on the various forms of life. Atmospheric pollutant dispersal modelling. Solid waste collection. Solid waste management. Refuse processing, recovery and conversion to useful products. Functions of environmental regulatory bodies.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 513: Petroleum Economics (3 Units; Core; L = 45; P = 0)**

**Senate-approved relevance**

Petroleum engineers perform technical work to support the business objectives of the organization they work for (corporation, government). It is therefore important that they understand that business because it will influence the judgments they make. Economic evaluations provide the main source of the organization's information by which investment and operational decisions are made regarding the most effective use of resources. There are many subtleties and assumptions that underlie the apparently straight-forward economic calculations that are often seen. Consequently, a fundamental understanding of the concepts behind economic evaluation and of techniques for performing them within a petroleum context is essential skills.

**Overview**

This course introduces the students to the fundamentals of petroleum economics and provides students with essentials to make informed economic decisions and forecasts as it relates to the petroleum industry and to develop economic sensitivity of engineers. A general overview of the petroleum industry will be discussed. Key economic principles such as cash flow, risk and uncertainty, oil & gas demand and supply etc. will be covered.

**Objectives**

The objectives of the course are to:

1. to give broad understanding of petroleum economics and prepare students to make economic analysis and evaluations
2. analyse geopolitical characteristics of the oil and gas industry
3. perform economic analysis of oil and gas projects
4. develop economic sensitivity of engineers
5. provide deep petroleum economics knowledge and intellectual breadth
6. raise awareness of students in the uncertainty and risks associated with oil and gas projects
7. provide economic criteria to screen and rank projects

**Learning Outcomes**

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

1. explain petroleum economics in all its aspects: reserves, investments, costs, benchmarking
2. describe the present oil and gas market
3. discuss how economics affects oil & gas reserves definitions
4. discuss the impacts of oil and gas regulatory agencies on the demand and supply of petroleum
5. make simplified forecast of oil production
6. use cash flow techniques in economic analysis and evaluations
7. describe key factors that affect the time value of money and compute a discounted cash flow
8. build a simplified economic model of upstream project
9. apply risk analysis concepts to exploration and production investments
10. discuss international agreements and evaluate terms of oil and gas contracts

**Course Contents**

Petroleum Industry. Geopolitical characteristics of the oil and gas industry. Reserves and production forecast. Oil and gas demand and supply. National and International regulators (OPEC and GECF). Crude oil sale contracts and gas sales. Cash flow. Economic Decision Tools. Risk and Uncertainties including Monte Carlo simulation. Petroleum Industry Accounting. Budgeting, planning, scheduling. International Agreements as it relates to oil and gas business.

**BUK-PEE507: Integrated Asset Development (Capstone Design) (3 Units C LH 15 PH 90)**

**Senate approved relevance**

Capstone design encompasses previously acquired skills from all the courses undertaken to solve a petroleum engineering problem. It expected to teach students ability to work as a team and independently. It also teaches them the steps required in solving practical technical problems found in the petroleum industry. This will lead to the production of high-quality petroleum engineering graduates.

**Course Overview**

This course is aimed at developing students’ creativity and engineering design skills in the process of meeting established design objectives with the consideration of economic factors, safety, reliability, aesthetics, ethics, and/or social impact. It involves groping the students into project teams to solve practical problems that relates to the oil and gas industry through the development and use of design methodology, synthesis, analysis and ideally construction, testing, and evaluation.

**Learning Objectives**

**The objectives of this course are to:**

1. provide design experience to the students through teamwork and familiarize them with the project management methodology.
2. provide the ability to understand and redefine a given engineering problem, and the to develop a conceptual design
3. Put into consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors in engineering design.
4. manage concept generation and concept evaluation process,
5. analyse and compare design alternatives/possible solutions, at the system and subsystem levels, and use measures of performance or other criteria to rank alternatives
6. execute manufacturing/ simulation/ implementation plan by selecting the suitable manufacturing/ simulation/ implementation techniques.
7. provide students the ability to communicate effectively.
8. manage design documentation and communication (both orally and in writing) using language and graphics appropriate to the topic, with the necessary supporting material, to achieve desired understanding and impact.
9. provide students with the experience of realization of a product from conceptual design to working model.

**Learning Outcome**

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

1. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. communicate effectively with a range of audiences.
4. recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. acquire and apply new knowledge as needed, using appropriate learning strategies.

**Course Content**

Capstone design encompassing previously acquired skills; project teams formed to solve practical petroleum engineering problems using current tools; technical content of the projects may include any combination of drilling and completion, formation evaluation, inflow/outflow design and analysis, and application of reservoir engineering principles. Actual field data is used in developing a comprehensive design solution to a petroleumengineering problem.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 504 Natural Gas Processing (2 Units, Core: L= 30, P=0)**

**Senate-approved relevance**

The relevance of the course will be seen in students from BUK as being able to demonstrate the knowledge and skills of natural gas processing in the oil and gas industry.

**Overview**

This course will introduce students into the concept of natural gas processing. The forms of natural gas, the natural gas separation processes, the various uses of natural gas (both domestic and industrial). No prior knowledge of natural gas is required for this course.

**Course Objectives**

The objectives of the course are to:

1. discuss natural gas and its various forms
2. explain the natural gas separation processes
3. discuss the various uses of natural gas
4. discuss natural gas impurities and their removal
5. describe natural gas industrial processes
6. discuss hydrate formation

**Learning Outcomes**

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

1. define natural gas and explain the forms of natural gas
2. describe the natural gas separation processes
3. know the various uses of natural gas
4. differentiate between NGLs, LPGs and LNGs
5. know the natural gas impurities and their effects
6. describe the dehydration and sweetening process of natural gas
7. describe the natural gas industrial utilisations such as Fisher-Tropsch synthesis, ammonia synthesis, methanol synthesis
8. know the factors that affect hydrate formation and how it can be mitigated

**Course Contents**

Natural gas and its forms. Review the gas laws and phase behaviour of natural gas. Natural gas separation processes. Natural gas dehydration and sweetening. Characteristics of Liquefied natural gas, Liquefied petroleum gas, and Natural gas liquids. Natural gas industrial utilisation. Hydrate formation.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 506: Offshore Operations (2 Units, Core: L= 30, P=0)**

**Senate-approved relevance**

The relevance of the course will be seen in students from BUK as being able to demonstrate knowledge and skills of the various offshore operations.

**Overview**

This course will introduce students into the various operations that are carried out offshore, ranging from offshore rigs/platforms, subsea operations, offshore production, offshore logistics and planning.

The module will prepare students to be able to identify and understand the different deep water operations carried out offshore. No prior knowledge of offshore operations is required for this course.

**Course Objectives**

The objectives of the course are to:

1. understand offshore rigs/platforms with their individual characteristics.
2. understand the concept of subsea operations including ROVs
3. introduce students to FPSO
4. understand the various process systems in offshore production
5. understand offshore operations logistics and contingency planning
6. understand offshore waste disposal and oil spill management
7. understand offshore safety and its importance

**Learning Outcomes**

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

1. describe offshore rigs/platforms with their individual characteristics
2. describe subsea operations and state the importance of ROVs
3. discuss the characteristics and purpose of a FPSO facility and state the different process modules on a FPSO
4. explain in details, the various process systems in offshore production
5. describe how offshore operations logistics is carried out and what contingency plans are put in place in cause of an accident or near miss.
6. describe the offshore waste disposal and how oil spillage is managed
7. state the importance of safety and the safety measures put in place in an offshore facility

**Course Contents**

Offshore rigs and platforms. Offshore logistics and contingency planning. Offshore production systems. Plant Start-up/Restart. FPSO Familiarization. Produced water treatment and operation. Subsea operations. Emergency, plant and process shutdowns. Pigging operations. Interpretation of offshore PFD and P&ID. Offshore auxiliary system. Permit to Work. Offshore waste disposal. Offshore loading and offloading. Offshore oil spill management.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 512: Petroleum Product Transport and Storage (2 unit; core; L=30)**

**Senate-approved relevance**

Petroleum engineers are not only known to have expertise in developing fields and production of crude oil. They are also expected to have a very good understanding of the complete lifecycle of crude oil including it various value chains and supply chains. The course focuses on the transportation and storage of petroleum and its product. Knowledge obtained from this course will make our graduate very valuable.

**Overview**

The course aims to familiarize the students with the various mode of transportation as well as storage of the produced crude. It also predisposes the students on how best the crude can be handle up until the point where distribution and custody transfer is done. The proper handling is important to mitigate the risk and prevent incidence occurrence.

The course also emphasizes on the need to attain standard quality of the crude prior to storage or custody transfer.

**Learning Objectives**

The objectives of the course are to:

1. learn the various means of crude transportation
2. provide knowledge of the quality requirement of the produced oil to meet the necessary standard
3. give priority to safety operations to prevent accidents during loading and unloading
4. understands the different types of storage facilities for the crude and natural gas
5. undertake distribution and custody transfer
6. have knowledge of the treatment of produced water and disposal of the same as per the regulatory authorities

**Learning Outcome**

On completion of the course, student should be able to:

1. explain the various means of crude oil transportation
2. describe the quality of oil required by the refinery, and ensure the necessary standard is achieved
3. operate various safety systems fitted from well to the surface equipment, storage, pumping stations to ensure accident free operations
4. proposed the most efficient and cost effective mode of transportation and storage for crude in different production platforms
5. undertake distribution and custody transfer of the crude

**Course contents:**

Transportation of crude oil: Pipelines; tankers loading and unloading techniques, offshore loading systems, international regulations on tanker transportation. Custody transfer, storage of crude oil, tank farm operations; gauging, sampling, quality control, underground storage caverns, porous rock. Gas transportation. Storage of natural gas; pressure tanks; re injection in porous rock, storage in caverns. Storage of LNG. Pipelines and transportation, maximum pipeline capacity, other transportation system. Metering of oil and gas; problem associated with flow measurement, flow measurement systems; liquid level controllers.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 514: Enhance oil Recovery (3 unit; core; L=45; P=0)**

**Senate-approved relevance**

As oil reservoir depletes, special set of skills are required to be able to continue to produce oils from such reservoirs. This course aims to expose students to such knowledge skills, which will, with a doubt, enhance the marketability of our students. This is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

The course predisposes the students to build a good understanding of an in-depth mechanisms involved in oil and gas recovery methods.

It predisposes the student to improved recovery methods ranging from polymer, thermal and surfactant recovery

**Objectives**

The objectives of the course are to:

1. understand the secondary and tertiary recovery means of crude oil
2. understand the selection criteria to which a particular reservoir suit for specific EOR technique
3. knowledge of maintenance of injection wells and production wells
4. knowledge of ignition of injection wells in case of thermal EOR
5. provide the knowledge of handling of chemicals such as surfactants, polymers employed in chemical means of EOR.

**Learning Outcomes**

On completion of the course, student should be able to:

1. identify the basic concept of enhanced oil recovery
2. describe detail knowledge about the various EOR techniques employed in oil and gas industry
3. explain the concept of miscible displacement of hydrocarbon
4. explain the concept, selection criteria and design gas injection mean of EOR
5. describe the concept of chemical and thermal means of enhance recovery of oil

**Course contents:**

Principles of displacement: rock properties; fluid properties in reservoir, phase behaviour, displacement efficiencies. Gas Methods: Miscible slug process, enriched gas drive, high pressure gas injection; carbon dioxide, nitrogen, and other inert gas. Chemical methods; micellar-polymer, polymer augmented water flood, permeability alteration, and caustic method. Thermal Method; steam stimulation, steam drive, in-situ combustion.

**Minimum Academic Standards**

Same with NUC-CCMA requirement facilities

**BUK-PEE 571: Multiphase flow in pipes (2 unit; Elective; L=30)**

**Senate Approved Relevance**

To ensure there is flow of oil and gas in the pipeline during production, an understanding of the different types of multiphase flow patterns is required. A petroleum engineering graduate equipped with such understanding would surely be above his/her peers in the industry. This is in line with BUK’s mission and vision of producing high-quality graduates that are well-skilled and knowledgeable.

**Overview**

The course gives a general introduction to the theory of multiphase flow and provides the necessary theoretical basis for the design of multiphase pipe flow lines, intended for use in oil and gas transport

**Course objectives:**

The objectives of the course are to

1. learn the principles of two-phase flow in pipes
2. learn basic knowledge of the general energy equation
3. understand the different flow patterns in a multiphase flow in pipes
4. learn the various pressure loss, their prediction methods, and flow restrictions

**Learning Outcome**

On completion of the course, student should be able to:

1. describe the principles of two-phase flow in pipes
2. explain the general energy equation and its application in determining energy losses in flow
3. identify and explain the different flow patterns in multiphase flow systems
4. understand and calculate the various pressure losses, their prediction methods, and flow restrictions

**Course content**

Principles of two-phase flow: The general energy equation; Evaluation of friction losses. Single phase flow. Variables used in two-phase flow. Flow patterns. Horizontal flow: Horizontal pressure loss prediction methods. Prediction of horizontal flow patterns. Flow through restrictions.

**BUK-TCH 562: Petroleum Processing and Petrochemicals (2 Units; Elective; L = 30)**

**Senate-approved relevance**

Petroleum products include transportation fuels, fuel oils for heating and electricity generation, asphalt and road oil, and feedstocks for making the chemicals, plastics, and synthetic materials that are in nearly everything we use. Petroleum is a part of many chemicals and medicines and is used to make crucial items such as heart valves, contact lenses, and bandages. Oil reserves attract outside investment and are important for improving countries' overall income. So, it is the mission of the university to train high-quality graduates who are highly skilled and knowledgeable in the design, construction, and maintenance of processes and systems of petroleum refining and the by-products referred to as petrochemicals and agree with the mission to address energy challenges in producing chemical engineering, graduates, that will be able to explore and process petroleum.

**Overview**

Petroleum Processing and Petrochemical are vital to meeting the energy demands of our country. The design of the system and process where petroleum products are produced is important to a chemical engineer. The petroleum industry, also known as the oil industry or the oil patch, includes the global processes of exploration, extraction, refining, transportation (often by oil tankers and pipelines), and marketing of petroleum products. The largest volume products of the industry are fuel oil and gasoline (petrol). The heavy by-products are also important. This highlights the importance of preparing students in chemical engineering with the knowledge and skills on how to design systems and processes of petroleum refining and petrochemicals.

This course is designed to expose students to various techniques involved in Petroleum Processing and Petrochemical production. The importance of the course lies in meeting the need for conversion of crude oil to end products that consist of the different products obtainable from crude oil. 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 the geologic processes and conditions that lead to the formation of oil and gas deposits;
2. explain the chemistry of petroleum and the differences between various types of crude oil;
3. describe the Nigeria sweet crude petroleum assay (bonny light and Kolmani crude);
4. describe the process of crude oil distillation and primary refining, including the separation of different fractions of oil;
5. describe the process of heavy oil processing and oil blending, and their impact on the properties of oil;
6. describe the petrochemical processes used to produce specific products such as Adipic acid, nylon, PVC, Polypropylene, polyethene, and insecticides;
7. enumerate the challenges and strategies for planning a petrochemical industry for a developing country;
8. explain the economic and environmental impact of the petrochemical industry and the challenges related to sustainable development;

**Learning outcomes**

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

1. list at least two (2) tools and techniques used in each of the processes of oil exploration, drilling and production;
2. describe at least two (2) effects of catalytic and thermal cracking on the properties of oil;
3. describe at least two (2) petrochemical feedstocks and their uses in the production of different chemical products;
4. list at least four (4) relevance of non-oil fossil fuels to the petrochemical industry;
5. describe at least three (3) stages of development of oil and gas production;
6. draw a process flow diagram for the production of polypropylene;
7. list at least four (4) challenges to establishing a petrochemical industry in a developing nation;
8. list two (2) environmental impact of the petrochemical industry and their challenges related to sustainable development;

**Course content**

Origin of oil and gas. Oil exploration drilling and production. Chemistry of petroleum. Crude oil distillation and primary refining. Catalytic and thermal cracking. Heavy oil processing. Oil Blending. Petrochemical feedstocks. Products specification. Petrochemical process: Adipic acid, nylon, nylon-6-6. PVC. Polypropylene, polyethene, insecticides etc. The non-oil fossil fuel and their relevance to the petrochemical industry. Models of crude oil distillation. Refining. Planning the petrochemical industry for a developing country. Design and simulation of modular refinery. Economic and environmental impact of the petrochemical industry. Mitigation plans for environmental pollution.

**Minimum Academic Standards**

Petroleum Engineering laboratory with NUC-MAS requirement facilities