**BAYERO UNIVERSITY KANO**

**FACULTY OF ENGINEERING**

**DEPARTMENT OF CIVIL ENGINEERING**

**B. Eng Civil Engineering**

**30% Addition to the CCMAS Course Structure/Summary**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **100 LEVEL** | | | | | |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-CEE 101 | Elementary Mathematics III (Vectors, Geometry and Dynamics) | 2 | C | 30 | - |
| BUK- CEE 102 | General Physic III  (Electricity and Magnetism) | 2 | C | 15 | 45 |
| BUK- CEE 103 | General Chemistry II  (Inorganic Chemistry) | 2 | C | 15 | 45 |
| BUK- CEE 104 | General Chemistry III  (Organic Chemistry) | 2 | E | 15 | 45 |
| **Total: 06** | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **200 LEVEL** | | | | | |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-GET 207 | Applied Mechanics | 3 | E | 30 | 45 |
| **Total** | | **03** | | | |

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| --- | --- | --- | --- | --- | --- |
| **300 LEVEL** | | | | | |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| BUK-CEE 301 | Soil Mechanics I | 3 | C | 30 | 45 |
| BUK-CEE 302 | Principles of Construction | 2 | C | 30 | - |
| BUK-CEE 303 | Civil Engineering Drawing II | 2 | C | 15 | 45 |
| BUK-CEE 304 | Design of Reinforced Concrete Structures I | 2 | C | 30 |  |
| **Total: 09** | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **400 LEVEL** | | | | | |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| \*CEE 406 | Engineering Surveying and Photogrammetry II | 3 | C | 30 | 45 |
| BUK-CEE 401 | Soil Mechanics II | 2 | C | 30 | 30 |
| BUK-CEE 402 | Design of Transport Infrastructure | 2 | C | 30 | 30 |
| BUK-CEE 403 | Structural Analysis II | 2 | C | 30 | 30 |
| BUK-CEE 404 | Civil Engineering Practice | 3 | C | 30 |  |
| BUK-CEE 405 | Design of Steel Structures | 2 | C | 30 |  |
| BUK-CEE 406 | Hydraulics/Hydrology | 3 | C | 30 | 45 |
| BUK-CEE 407 | Introduction to Transportation Engineering | 2 | E | 30 |  |
| **Total: 17** | | | | | |

\*Elective course in 70% CCMAS but adopted as a core course

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **500 LEVEL** | | | | | |
| **Course Code** | **Course Title** | **Units** | **Status** | **LH** | **PH** |
| \*CEE 506 | Construction Engineering | 3 | C | 30 | 45 |
| BUK-CEE 501 | Geotechnical Engineering | 3 | C | 45 | 45 |
| BUK-CEE 502 | Traffic Engineering | 3 | C | 45 | 45 |
| BUK-CEE 503 | Structural Analysis III | 3 | C | 45 | 45 |
| BUK-CEE 504 | Design of Reinforced Concrete Structures II | 3 | C | 45 | 45 |
| BUK-CEE 505 | Water Resources Engineering | 3 | C | 45 | 45 |
| BUK-CEE 505 | Public Health Engineering | 3 | C | 45 | 45 |
| BUK-CEE 507 | Transportation Planning | 2 | E | 30 | - |
| BUK-CEE 508 | Analysis and Design of Timber Structures | 2 | E | 30 | - |
| BUK-CEE 509 | Prestressed concrete design | 2 | E | 30 | - |
| BUK-CEE 510 | Rock Mechanics | 2 | E | 30 | - |
| BUK-CEE 511 | Irrigation and drainage Engineering | 2 | E | 30 | - |
| **Total: 21** | | | | | |

\*Elective course in 70% CCMAS but adopted as a core course

**Total Core Units Developed = 50**

**Total Elective Units Developed = 14**

**Total Units Developed = 64**

**BUK-CEE 101: Elementary Mathematics III (****Vectors, Geometry and Dynamics)**

**(2 Units C: LH 30)**

**Senate Approved Relevance**

The basic mathematical concept is necessary in producing engineers that can be able to analyse, design and construct structures for national development. This course provides engineering basis which will help the students to understand engineering theories and is in line with BUK’s mission to address African developmental challenges by producing high quality engineering graduates.

**Course Overview**

This course introduces students to the concept, importance and useful quantities called vectors that arise when studying physical systems.

The course will also introduce the students to the analysis of two-dimensional surfaces and concept of dynamics.

**Course Objectives**

The objectives of the course are to:

1. Introduce the concept of Vectors, Geometry and Dynamics;
2. Representation of vectors, its component and direction and do some vectors addition and multiplication;
3. write equations of straight lines, circles, parabola, ellipse and hyperbola;
4. calculate force and momentum of a moving particle, and
5. Explain the components of velocity and acceleration of a particle moving in a plane

**Learning Outcomes**

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

1. Explain how to represent vectors in 1-3 dimensions;
2. Explain and solve some vectors in addition and multiplication;
3. Recall and explain how to calculate force and momentum;
4. Recall how to solve differentiation and integration of vectors;
5. Recall how to write equations of straight lines, circles, parabola, ellipse and hyperbola, and
6. Explain the components of velocity and acceleration of a particle moving in a plane.

**Course Contents**

**(Pre-requisite –MTH 101)**

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

**BUK-CEE 102: General Physics III (Electricity and Magnetism)**

**(2 Units C: LH 15; PH=45)**

**Senate Approved Relevance**

The concept and application of electricity and magnetism is highly required in producing high-quality graduates that can understand services engineering in all civil drawing construction. This is in agreement with mission of BUK of producing high quality graduates to address African developmental challenges.

**Course Overview**

This course introduces students to the fundamental principles of electricity such as the concept of potential difference, electric current, coulomb’s Law and basic fundamental Laws such as Ohm’s law, Ampere’s Law and Kirchhoff’s Laws.

The course will also introduce basic properties, construction and formulas of Resistors, Inductors and capacitors as Electrical Circuit Elements (RLC), series and parallel combination of RLC, electrical energy and power of RLC.

It will also introduce the students to the fundamental magnetism circuits and its analogies with electrical circuits and corresponding calculations and computations and Faraday’s law of electromagnetic induction.

**Course Objectives**

The objectives of the course are to:

1. Explain common properties and atomic structure of metals, conductors, insulators, and semiconductors;
2. Explain Ohm’s law, Ampere’s Law and Kirchhoff’s Laws and simple calculations;
3. Explain the construction process of resistors, capacitors and inductors;
4. Calculate total resistance in a given circuit when the resistors are arranged either in series or in parallel,
5. Explain magnetic theory with their equivalent electrical analogies, and
6. Explain Faraday’s law of electromagnetic induction.

**Learning Outcomes:**

The students should be able to:

1. Explain common properties and atomic structure of metals, conductors, insulators, and semiconductors;
2. Explain Ohm’s law, Ampere’s Law and Kirchhoff’s Laws;
3. Explain the concept of current and voltage in relation to real world analogies;
4. Explain the construction process of resistors, capacitors and inductors with their properties;
5. Explain series and parallel combination of RLC;
6. Explain the concept of magnetic theory with their equivalent electrical analogies, and
7. Explain Faraday’s law of electromagnetic induction.

**Course Content**

Fundamentals of Electricity: Potential difference, Electric current, Coulomb’s Law. Properties and atomic structure of metals, conductors, insulators, and semiconductors. Basic Fundamental Laws: Ohm’s law, Ampere’s Law and Kirchhoff’s Laws. Electrical Circuit Elements (RLC): Basic Properties, construction and formulas of Resistors, Inductors and Capacitors. Series and parallel combination of RLC. Electrical Energy and Power of RLC. Fundamentals of Magnetism: Basics of Magnetic theory: Magnetic Flux, Magnetic Field Intensity, and Permeability. Derivation, relationships and units of the above. Magnetic circuits: Concepts and analogies with electrical circuits, Calculations and computations. Faraday’s law of electromagnetic induction. Electromagnetic Oscillations and Waves.

**BUK-CEE 102 Laboratories**

Ohms Law (EMF and Internal Resistance): Investigate variation of potential difference of cell and verification of the relationship between current and voltage in a DC circuit. Parallel and Series Connections (Meter Bridge): To investigate series and parallel connection formulae and measurement of unknown resistance. Potential Divider: To understand the concept of developing variable potential difference.

**BUK-CEE 103: General Chemistry II (Inorganic Chemistry) (2 Units C: LH 15; PH=45)**

**Senate Approved relevance**

The concept and application of inorganic chemistry is highly required in producing high-quality Civil engineering graduates that can understand chemical reaction that occurs when two or more materials are combine together in the construction process. This is in agreement with mission of BUK of producing high quality graduates to address African developmental challenges.

**Couse Overview**

The course is designed to acquaint students with the fundamental aspects of inorganic chemistry and its applications. The course will introduce the concept and principles of atomic structure; hybridization and shapes of simple molecules.

The extraction of metals will be introduced with comparative chemistry of groups IA, IIA and IVA elements. Introduction to transition metal chemistry and nuclear chemistry with overview of their applications

**Couse Objectives**

The objectives of the course are to:

1. Explain the concept and principles of atomic structure; isotopes, empirical and molecular formulae, electronic configuration, periodicity and building up of the periodic table;
2. Explain the concept of hybridization and shapes of simple molecules;
3. Explain the process of metals extraction;
4. Explain the concept of comparative chemistry of groups IA, IIA and IVA elements;
5. Explain the preparation, properties, structure and application of some selected compounds, and
6. Introduce transition metal chemistry and nuclear chemistry with overview of their applications.

**Learning outcomes.**

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

1. Explain how matter works in the universe focusing on the composition, properties, structure and its transformations;
2. Explain the principles that governs all these given aspects;
3. Explain how to carry out some measurement, conversions and computations of chemical equations
4. Explain the name and write chemical equations and perform stoichiometry analysis to enhance their capacity of understanding chemistry and the subjects’ practical utilization to our daily life.
5. Identify the core concepts of inorganic chemistry with its application.

**Course content**

Principles of atomic structure; isotopes, empirical and molecular formulae, electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Extraction of metals. Comparative chemistry of groups IA, IIA and IVA elements. Preparation, properties, structure and application of some of the selected compounds. Introduction to transition metal chemistry and nuclear chemistry with overview of their applications.

**BUK-CEE 103 Laboratories**

Determination of the number of molecules of water crystallization of hydrated sodium carbonate. Determination of the degree of temporary hardness in water. Qualitative analysis. Identification of anions or acids radicals. Identification of metallic cations

**BUK-CEE 104: General Chemistry III (Organic Chemistry) (2 Units E: LH 15; PH 45)**

**Senate Approved relevance**

The concept and application of organic chemistry is highly required in producing high-quality Civil engineering graduates that can understand qualitative and quantitative of structures in organic chemistry. This is in agreement with mission of BUK of producing high quality graduates to address African developmental challenges.

**Course Overview**

This course is designed to provide fundamental overview of organic chemistry to students in engineering. The concept of nanotubules, nanostructures, nano-chemistry will be introduced to the students.

The application nano materials in engineering will be introduced to the students.

**Course Objectives**

The objectives of the course are to:

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

**Course Contents**

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

**BUK - CEE 207: Applied Mechanics (3 Units E: LH 30 PH 45)**

**Senate Approved Relevance**

Engineering components and systems can either be static or in motion and the behaviour varies depending on the state of existence of the component/system. Understanding the concept and application of applied mechanics is highly required in producing high-quality Civil engineering graduates that can understand, describe and analyze components and systems so as 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. This is in agreement with mission of BUK of producing high quality graduates to address African developmental challenges.

**Course Overview**

This course is made up of two components; the static and dynamics. The static aspect will introduce analysis of forces acting on engineering structures at rest by quantifying and predicting their effects.

The dynamic aspect of the course will introduce the analysis of motion of engineering components and systems with and without consideration to the forces causing the motion.

**Course Objectives**

The objectives of the course are to:

1. State the fundamental principles of applied mechanics;
2. Describe the equilibrium analysis, friction, kinematics and momentum;
3. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
4. Describe the Newtonian Physics with static analysis to determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints);
5. Describe a particle in motion by categorizing it into either rectilinear, plane or space curvilinear;
6. Describe motion based on the co-ordinate system i.e either rectangular, normal & tangential, polar, cylindrical or spherical;
7. Apply Newton’s second law, work-energy and impulse-momentum equations for the solution to problems in particle kinetics;
8. Describe the approach of absolute or relative motion in the analysis of rigid bodies in motion and simple mechanisms.

**Learning Outcomes**

Students will acquire the ability to:

1. explain the fundamental principles of applied mechanics;
2. Understand equilibrium analysis, friction, kinematics and momentum;
3. identify, formulate, and solve complex engineering problems by applying principles of engineering, science, mathematics and applied mechanics;
4. synthesize Newtonian Physics with static analysis;
5. determine the complete load impact (net forces, shears, torques, and bending moments) on all components (members and joints) of a given structure with a load; and
6. apply engineering design principles to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

**Course Contents**

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

**BUK-CEE 301: Soil Mechanics I (3 Units; Core, LH = 30, PH = 45)**

**Senate Approved Relevance**

Failure of many Civil engineering structures such as buildings, highways, bridges, dams, embankments, etc. initiated from foundation soil. Therefore, this course is designed to provide the student with a level of understanding of ground conditions to ensure that engineering works are constructed at the estimated time and cost, and such works should not fail as the result of any misunderstanding or lack of knowledge about the nature of the soil conditions. This is in line with BUK’s mission of producing high quality graduates that can address African developmental challenges in producing civil engineering graduates.

**Course Overview**

Civil engineering projects are designed and executed by civil engineers and most of these projects involve some excavation of soils and rocks, or involve loading the soil by building on it.

Therefore, this course will equip students with the knowledge of soil mechanics for construction applications. So that they can apply the knowledge on basic soil properties, water in soil and shear strength parameters in planning, analysis, design and supervision of related civil constructions.

**Course Objectives**

The objectives of the course are to:

1. Describe and solve volume-mass relationship equations for soils;
2. Describe the concept particle size analysis and perform particle size analysis using dry and wash sieving and hydrometer analysis;
3. Plot the particle size analysis results and interpret the results;
4. Describe the concept of Atterberg Limits (Liquid limit, plastic limit and shrinkage limit) and conduct experiment in the laboratory to determine these limits;
5. Classify soils using USCS and AASHTO for engineering application;
6. Determine seepage and permeability and solve for flux and flow behaviour in soils;
7. Describe the concept and theory of shear strength, determine shear strength parameters using direct shear, triaxial, and vane shear tests and application of shear strength parameters in design;
8. Conduct shear strength tests using shear box and triaxial machines and interpret the results; and
9. Describe the concept of stress distribution in soil.

**Learning Outcome**

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

1. Describe and solve volume-mass relationship equations for soils.
2. Describe the distinction between gravel, sand, silt and clay based on particle size and be able to produce particle size distribution curve of soil sample;
3. Describe Atterberg limits of soil and how to determine each limits;
4. Classify soils for engineering applications using USCS, AASHTO, etc.;
5. Determine seepage and permeability and solve for flux and flow behaviour in soils.
6. Describe the concept and theory of shear strength;
7. Determine shear strength parameters using direct shear, triaxial, and vane shear tests and application of shear strength parameters in design; and
8. Describe the concept of stress distribution in soil.

**Course Contents**

Introduction - Soil formation from weathering process, Soil properties, structure and clay minerals. Phase relationships -Water content,Void ratio, porosity, degree of saturation, specific gravity, density and unit weight. Mass-volume relationships. Soil Classification - Importance of soil classification. Grain size distribution by sieve analysis and hydrometer analysis, Atterberg's limits, classification systems (e.g., USCS, AASHTO, etc.). Seepage, Permeability and Groundwater flow - Darcy's law, factors affecting permeability, method of determination of permeability (laboratory and field). Introduction to flow nets. Estimation of seepage quantity and gradients. Shear strength of soils -Concept of shear strength, shear strength parameters, the Mohr-Coulomb failure criterion, Factors affecting shear strength of soil, shear strength tests and applications of shear strength parameters in civil engineering. Stress Distribution in Soils - Elements of stress analysis (total stress and pore pressure, effective stress, stresses at a point in a soil mass, stresses due to self-weight and stresses due, to applied loads. Stresses and Displacements - Influence charts, displacements from the theory.

**Laboratory Practical**

Determination of the particle size distribution. Subsidiary method by dry sieving. Standard method for fine grained soils (hydrometer and pipette methods). Determination of the moisture content (standard method – oven drying method). Determination of Atterberg limit (liquid limit, plastic limit and shrinkage limit)

**BUK-CEE 302 Principles of Construction (2 Credits, LH = 30)**

**Senate Approved Relevance**

The success of every project lies on site planning, selection of appropriate construction materials, techniques and tools. Therefore, this course is designed to provide the student with a level of understanding of various forms of techniques of building and civil engineering construction with a view of producing building and civil engineering structures at estimated time and cost. This is in line with BUK’s mission of producing high quality graduates that can address African developmental challenges in producing civil engineering graduates.

**Course Overview**

This course will introduce students to the principles of construction in building and civil engineering works.

This consists of site preparation, and layout, earthwork activities, construction of various building elements such as foundation, floors, walls and roofs.

**Course Objectives**

The objectives of this course are to:

1. Differentiate between building and civil engineering works;
2. Describe and illustrate construction tools and techniques used in building and civil engineering works;
3. Distinguish between building elements and different types of construction techniques and tools used for their construction;
4. Explain and illustrate effectively and with confidence the various types of construction techniques used in building and civil engineering works including sustainable environment issues; and
5. Expose the students to typical procedure of executing all civil engineering projects.

**Learning Outcome**

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

1. Understand and clearly differentiate between building and civil engineering works;
2. Describe construction tools used in building and civil engineering works;
3. Describe construction techniques used in building and civil engineering works;
4. Describe various types of construction techniques used in building and civil engineering works; and
5. Describe procedure of executing all civil engineering projects.

**Course Contents**

**Introduction to Civil Engineering Procedure:** Definition and functions of the Civil Engineering profession. The design and construction teams. Introduction to the Principles of Civil Engineering design. Influence of erection procedure on design, operation and maintenance of Civil Engineering facilities. **General Considerations in Civil Engineering Works:** Introduction to site investigation, site organisation, temporary works, underpinning, earth works. **Elements of Construction:** Domestic, industrial and multi-storey buildings, construction of foundations (shallow and deep foundation e.g., pile), floors, walls, staircases, roofs and coverings, frame and space construction (internal fixtures and fittings, formwork and falsework, scaffolding, retaining walls, external works in buildings); fire protection, blasting and demolition works. Elements of construction: road works, drift structures subways, railways, air fields, hydraulic and liquid retaining structures, dams, harbours, docks, jetties, dolphins, seawalls, quay walls, breakwaters etc. Dredging and reclamation, irrigation and river banks works (training works), flood and erosion control works including use of gabions and geotextiles forms of lining, etc.,), pipe lines for water, gas and sewage, modular construction.

**BUK-CEE 303 Civil Engineering Drawing II (2 Credits, LH = 15, PH = 45)**

**Senate Approved Relevance**

This course is designed to exposed the students on how to appropriately produce drawings used in civil engineering constructions. Analysis and design of structural elements and other civil engineering structures occupied a lot of papers and used to be very bulky as such cannot be carried to site during construction stage. The important material taken to the siter is usually drawings. Therefore, this course will introduce student to manual and automated methods of producing civil engineering drawings. This is in line with BUK’s mission of producing high quality graduates that can address African developmental challenges in producing civil engineering graduates.

**Course Overview**

Drawing is known as language of engineers, and is one of the simplest ways through which engineers communicate among themselves.

This course is structured to equip students with skills for drawing various forms civil engineering structures. The course is designed in such a way that a state-of-the- art method will be utilized in teaching this course.

**Objectives**

The objectives of the course are to:

1. Apply the principles of basic technical skill and produce civil engineering drawings.
2. Introduce the concept of CAD in producing Civil engineering drawings
3. Use manual methods and produce Civil engineering drawings including steel structures, reinforced concrete structures, highway geometry, vertical and horizontal alignments, vertical and horizontal curves etc. and produced drawings related to water and environmental engineering.
4. Use AutoCAD methods and produce Civil engineering drawings including steel structures, reinforced concrete structures, highway geometry, vertical and horizontal alignments, vertical and horizontal curves etc. and produced drawings related to water and environmental engineering.
5. Describe bar bending schedule and be able to estimate total quantity of bars required from the drawings.

**Learning Outcome**

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

1. Apply the principles of basic technical skill and produce civil engineering drawings;
2. Describe and interprete the elements of Civil engineering drawings;
3. Utilise manual and CAD software to produce steel and reinforced concrete structures;
4. Utilize drawing and produce bar bending schedule and be able to estimate total quantity of bars required from the drawings;
5. Utilise manual and CAD software to produce Highway geometry and related drawings; and
6. Utilise manual and CAD software to produce water resources and environmental engineering related drawings such as dams, canals, tanks, etc.

**Course Contents**

Building drawings - Block plan, site plan, floor plans, elevations, cross-sections, typical details. Study of specific examples. Representation of steel sections, connections of steel structures. Reinforced concrete structures - Introduction to reinforcement bars, end anchorages of reinforcement, U and L hooks, notation and identification of bars on drawings. Detailed reinforcement drawings, sectional views of members and bar scheduling. Specific cases of beams, one-way slabs two-way slabs, columns, staircase, footings and foundation details. Applications of AutoCAD in the reinforced concrete detailing and structural steel detailing. Presentation of Highway/Transportation Engineering Drawings - Layout plans showing proposed road, existing structures; horizontal alignment of the proposed road, drains, location of bridges and railway crossings, horizontal curves; longitudinal section showing datum, the existing ground level, proposed longitudinal profile of the road, vertical curves, drainages, the proposed invert levels of drains and culverts. Cross-sections consisting of the extent of the road reserve, the road pavement, (showing base subgrade, base course and wearing course), drains and culverts, cross-slope and super-elevation: contours, representation of earthwork, cut and fills. Applications of AutoCAD in Highway/Transportation Engineering drawings. Water Resources/Environmental Engineering Drawings - Sections of earth dam, gravity dam, arch-dams, etc.; reservoirs, water tanks, pipe-layouts, manholes, septic tank and soakaway pit, sewers. AutoCAD in Water Resources/Environmental Engineering Drawings

**BUK-CEE 304 Design of Reinforced Concrete Structures I (2 Credits, LH = 30)**

**Senate Approved Relevance**

Through teaching of design of reinforced concrete, graduates of Bayero University are poised to contribute hugely in the provision of cost-effective building structures that could remarkably reduce the huge housing deficit that currently exist in Nigeria. The course is very relevant in this regard and is in-line with the mission and vision of Bayero University, Kano.

**Course Overview**

The course introduces students to design of reinforced concrete structural elements using established theorems and standards.

The course will also introduce students how check for deflection, cracks etc. to ensure that the structure will not fail within the design life span.

**Objectives**

The objectives of the course are to:

1. Introduce students to different design approaches
2. Describe material characteristics of reinforced concrete
3. Describe theorems and basic equations for the design of structural elements against flexure, shear, etc.
4. Describe theorems and basic equations for the design of structural elements against torsion, deflections etc.
5. Determine vertical and lateral load effects on low and mid-rise building structures

**Learning Outcome**

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

1. Describe and distinguish between the different design philosophies of engineering structures.
2. describe the concept of Reinforced Concrete Design.
3. Explain the composite action of reinforced concrete materials and design of sections in flexure, shear and bond.
4. Explain the composite action of reinforced concrete materials design against deflections, cracks and bond.
5. Describe the concept of approximate analysis method of frames for vertical and horizontal loads

**Course Contents**

Fundamentals of design process. Limit state design philosophy. Review of reinforced concrete materials for structural application. Introduction to Reinforced Concrete Design. Analyses of reinforced concrete sections in bending, shear, torsion and bond. Deflection and crack assessments in reinforced concrete elements. Approximate analysis method of frames for vertical and horizontal loads.

**BUK-CEE 401 Soil Mechanics II (2 Units; Core, LH = 15, PH = 45)**

**Senate Approved Relevance**

Failure of many Civil engineering structures such as buildings, highways, bridges, dams, embankments, etc. initiated from foundation soil. Therefore, this course is designed to provide the student with a level of understanding of ground conditions to ensure that engineering works are constructed at the estimated time and cost, and such works should not fail as the result of any misunderstanding or lack of knowledge about the nature of the soil conditions. This is in line with BUK’s mission of producing high quality graduates that can address African developmental challenges in producing civil engineering graduates

**Course Overview**

The course aims at giving the students a knowledge and understanding of the Consolidation theory and general compressibility characteristics of soils, different types of settlement, stress path.

The course will also expose the students to compaction and soil mechanics aspects of Highway Design and lateral earth pressure and retaining walls.

**Course Objectives**

The objectives of this course are to:

1. Describe compressibility and consolidation characteristics of soil;
2. Describe degree of consolidation and be able to determine coefficient of consolidation using established methods;
3. Describe settlement of a foundation including immediate settlement and consolidation settlement;
4. Describe compaction theory, various forms of compaction effort and compaction energy used in civil engineering projects;
5. Use appropriate Soil mechanics techniques for analysing related engineering problems; and
6. Work with limited information and extract basic information necessary to solve Soil Mechanics problems.

**Learning Outcome**

At the end of the course. The students are expected to:

1. Differentiate between compaction and consolidation;
2. Differentiate between normally consolidated, overcon­solidated, and underconsolidated soil;
3. Describe degree of consolidation and calculate coefficient of consolidation using established methods;
4. Describe compaction theory, three (3) forms of compaction effort and compaction energy used in civil engineering projects;
5. Describe the concept of lateral earth pressure and design of retaining walls;
6. Use appropriate Soil Mechanics techniques for analysing related engineering problems.

**Course Contents**

Compressibility and Consolidation: Introduction, consolidation test (the Oedometer test), compressibility characteristics, Pre-consolidation pressure and definition of ‘normally consolidated soil’, ‘overcon­solidated soil’, and underconsolidated soil’, degree of consolidation, coefficient of consolidation (log time method and root time method). Application of consolidation in civil engineering constructions. Settlement analysis: Settlement of a foundation, immediate settlement, consolidation settlement, stress path. Soil Compaction: Introduction, compaction theory, compaction effort and compaction energy (Standard Proctor, Modified Proctor and West African), relationship between dry density and moisture content, air void and degree of satura­tion for compacted fines soil. Dry density versus moisture content for clay and effect on different type soils. Introduction of compaction on site and effect on different type of soils, field compaction equipment and their application to different types of soil. Relative Density (degree of compaction for sandy soil). Lateral Earth Pressure: Introduction, Lateral Earth Pressure at rest, active and passive conditions. Rankine and Coulomb’s theory and lateral earth pressure diagrams. Retaining walls.

**BUK-CEE 402: Design of Transport Infrastructure (2 Units C: 30 LH; 30 PH)**

**Senate-approved relevance**

Producing highly skilled graduates with good knowledge of the design, construction, and maintenance of transport infrastructure in Nigeria is in agreement with BUK’s mission to address African developmental challenges in infrastructure design construction and maintenance. Consequently, BUK graduates will be able to use the opportunities offered by the renewed government commitment to the national integrated infrastructure development master plan.

**Course Overview**

The economy of every nation largely depends on efficient and safe transportation system which facilitates the movement of goods and services through cohesive and state of the art transport infrastructure. Demand for qualified specialists in this field is at an all-time high. Design of Transport Infrastructure course seeks to give students a basic knowledge of the design principles for transport infrastructure development.

The course will also enable students to design major transport infrastructure including road drainage, road pavement, road junction, railways and airport runway. A student will have a good understanding of techniques at the forefront of transport infrastructure design and construction, whilst exploring the latest technological developments, advanced materials and what the future holds for transport infrastructure asset management.

**Course Objectives**

1. To enable students to acquire basic knowledge of design principles for transport infrastructure development
2. To enable students to design major transport infrastructures including road drainage, road pavement, road junction, railways and airport runway.
3. To enable students to assess engineering judgment on alternative transport infrastructure designs.

**Learning Outcomes**

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

1. Describe the design principles of transport infrastructure including roads, railways and airport runways as well as the skills to plan and design transport elements such as road, railway and airport layout and structures;
2. Explain the common design computer packages as well as manual calculations for road drainage, junction and pavement designs as well as railway station and airport layout designs and be able to exercise professional judgments on design parameters;
3. Able to carry out and evaluate proper material tests for road pavements as well as tests on railway civil element requirements;
4. Able to formulate and design cost-effective transport infrastructure;
5. Able to write formal laboratory test reports and project report as well as analyze and present data in a logical way;
6. Able to work in groups and share responsibility in the required group works;
7. Able to understand the current transport infrastructure development issues and contribute to discussion on these contemporary issues.

**Course Contents**

Introduction: Basic consideration of transport infrastructure developments. Current development programs. Design concept. Highway Drainage: General considerations. Types of drainage structure. Design and construction of surface drainage and sub-soil drainage. Effects on pavement support. Pavements: Design principles for flexible and rigid pavements. Loading on pavements. Theoretical and empirical design methods. Pavement evaluation and rehabilitation. Types of pavement surfaces and mix designs (concrete, Asphalt and surface dress). Junction Design: Types of at-grade junction. Priority junctions and rotary junctions. Railway Design: Railway development. Railway capacity. Railway alignment. Rail joints and ballast. Airport Design: Airport activity systems. Airport planning procedure. Runway orientation. Runway length and layout design. Project: Design of Roadway/Railway/Runway Using BIM based software e.g. Civil 3D. Laboratory: Laboratory work will include: skid-resistance; pavement conditions studies; junction studies; and railway studies. Field data collection exercises will be undertaken and case studies will augment this course

**BUK-CEE 403: Structural Analysis II (2 Units; Core, LH = 30)**

**Senate Approved Relevance**

Teaching and transfer of skills towards equipping students in creative thinking, analyses and evaluation of structural elements and systems are essential in producing high quality civil/structural engineering graduate that can contribute effectively in addressing Nigeria’s developmental challenges. The course is very relevant in this sense and is in tandem with the mission and vision of Bayero University, Kano.

**Course Overview**

The course is a build-up to the concept and bases of structural element analyses.

It will expose the students to analysis of both determinate and indeterminate structures and equips students with requisite skills for determining structural responses to varied imposed loadings.

**Course Objectives**

The objectives of the course are to:

1. Understand the difference between statically determinate and statically indeterminate structures and analyses approaches applied to each of the systems.
2. Teach and demonstrate analyses of indeterminate beams and frames using varied analyses schemes.
3. Determine load response function of beams and trusses under time varying loads.
4. Analyse beams and frames using energy methods.

**Learning Outcomes**

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

1. Clearly distinguish between determinate and indeterminate structures.
2. Understand how to test of statically determinacy for plane structures.
3. Analyse and determine load effects of reactions, bending, shear and deflections as well as visualization of these effects using sketches/drawings
4. Understand and analyse beams and trusses under time varying loads
5. Apply energy and virtual work method in the analyses of indeterminate structures.

**Course Contents**

Difference between determinate and indeterminate structures. Test of statically determinacy for plane structures. Analyses of indeterminate structures for load effects of bending, shear and deflections using Clapeyron’s (three moment equation) method, Moment Distribution Method, Slope-Deflection Method and Moment Area Method. Influence line diagram for beam and truss systems. Energy and Virtual work methods.

**BUK-CEE 404: Civil Engineering Practice (3 Units; Core, LH = 45)**

**Senate Approved Relevance**

Producing highly skilled graduates with good knowledge of how civil engineering projects are measured, quantified and procured. The aspects of project monitoring and control systems, cost control measures in Nigeria is in agreement with BUK’s mission to address African developmental challenges in infrastructure design construction and maintenance. Consequently, BUK graduates will be able to use the opportunities offered by the renewed government commitment to the national integrated infrastructure development master plan.

**Course Overview**

This course is intended to acquaint the students with aspects of how civil engineering projects are measured, quantified and procured.

Students will also learn aspects of project monitoring and control systems, cost control measures.

**Learning outcomes**

1. To enable the students to be able to take off quantities directly from the civil engineering drawings.
2. To enable the students to build up the rates for various Civil Engineering works including estimating for labour, plant, materials and overheads.
3. To enable the students to be able to prepare valuation reports, interim certificates, final payments and costing of civil engineering works.
4. To expose the students to the application of equipment economics and cost estimation.
5. To enable the students to prepare and evaluate Bids for civil engineering works including award of contracts.
6. To enable the students to be able to apply the various computer software in estimation, measurements, costing of construction works etc.

**Course content**

Bidding and Procurement - Qualification of Bidders, Work Packages, Bidding and Contract Documents, Bidding Information including invitation to Bid, Instruction to Bidders, Bid Form Alternatives, Addenda, Contract Data; Analysis of Submitted Bids, Basis for Evaluation and Acceptance, Letter of Intent, Work Order. Concept of Public-Private Partnerships (PPP) and the Private Finance Initiative (PFI). Civil Engineering Works and Methods of Measurement - General scope of civil engineering works. Client`s Estimation of Project Cost including Approximate methods of estimation, Types of estimates, methods of structuring project costs. Illustrate cases in preparation of estimates for works such as Buildings, Reinforced Concrete works, Sanitary and Water Supply Works, Roads, Culverts, Bridges, Wells, Irrigation works, Piling, Overhead runway, Tunnel and Railway Trackwork, Gabions and other Geotextile materials, Jacked Box Subway, Marine structures etc. Contractors estimation of Cost and Bidding Strategy including Contractor`s estimation and bidding process, determination of optimum mark-up level, determining the bid price, Analysis of rates. General Arrangements and contents of Bills of Engineering Measurements and Evaluation (BEME). Costs of Construction - Contract Sum – adjustments to contract; Variations, change orders and Provisional sums; Damages for non-completion; loss and expense claims; Valuations, Certificates and Payments. Construction Machinery and Equipment - Equipment economics to include equipment records, Sources of equipment and machinery, equipment costs, elements of ownership costs, elements of operating costs. Cost estimation calculations for the use of the relevant machinery and equipment used in various civil engineering works such as piling, highway and pavements, hauling and transporting material, excavations, etc.

**BUK-CEE 405: Design of Steel Structures (2 Units; Core, LH = 30)**

**Senate Approved Relevance**

Through teaching of design of steel structures, graduates of Bayero University are poised to contribute hugely in the provision of cost effective housing and industrial building structures that will remarkably improve on their safety in Nigeria. The course is very relevant in this regard and is in-line with the mission and vision of Bayero University, Kano.

**Course Overview**

The course introduces students to design of steel structures using established theorems and both local and international standards.

The course will also provide rigorous of practicing typical design project based on the knowledge acquired.

**Course Objectives**

The objectives of the course are to:

1. Strengthen students knowledge on the properties of steel and grades
2. Introduce students to design codes and design of steel structures based on elastic and plastic theories.
3. Determine plastic and collapse moments and loads for steel structural elements.
4. Design of steel structures under flexure, tension, compression and shear
5. Introduce students to composite steel construction design
6. Execute typical design project on the knowledge acquired.

**Learning Outcome**

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

1. Understand the concept of structural steel design and section classification.
2. Use British and/or Euro codes as well as local standards in design of structural steel elements and systems.
3. Estimate imposed and self-weight of buildings and structures based on established theorems and standards
4. Design steel structures under tension, compression, flexure, shear and combination of either of the loadings in a structure.
5. Apply analytical skills acquired in design of a typical steel and/or composite steel structure as a design project.

**Course Contents**

Basic steel properties. Introduction to structural steel design and section classification. Elastic and Plastic theory of bending. Plastic analysis and determination of collapse loads in steel sections. Design of steel elements in tension. Design of steel elements under bending and shear. Design of compression members - Stanchions and foundations. Analysis and design of steel connections. Introduction to composite sections. Design project.

**BUK-CEE 406: Hydraulics/Hydrology (3 Units; Core, LH = 45; PH=45)**

**Senate Approved relevance**

In line with BUKs mission of providing excellent undergraduate education, the course is aimed at producing high quality engineering hydrologists who are capable of collecting, interpreting and analysing hydrological data, who are conversant with hydrology of Kano region in particular and that of the nation in general. The course is also aimed at producing hydraulic engineers that can analyze and design open channels for the purpose of stormwater management and water conveyance.

**Course Overview**

The course introduces students to the concept of open channel flow and various methods of collecting, interpreting and analysing hydrological data fir the design of water infrastructures.

The course will also expose students to understand the applications of various software (HEC-HMS, HEC-RAS, etc) used in catchment hydrology.

**Learning Outcome**

1. To analyze uniform flows in open channels using Chezy’s and Manning’s formulae
2. To classify non-uniform flows into rapidly varied flows and gradually varied flows
3. To analyze rapidly varied flows (Hydraulic jumps)
4. To use the dynamic equation of gradually varied flows to analyze different flow cases corresponding to different water surface profiles
5. To explain meteorology
6. To explain the basic meteorological instruments used to measure weather
7. To know the hydrologic cycle and water balance equation
8. To conduct calculations of the various components that make up the hydrologic cycle such as precipitation, evapotranspiration, infiltration, surface runoff, etc
9. To analyze hydrograph for the estimation of runoff
10. To develop unit hydrograph
11. To use various methods to estimation rainfall-runoff.
12. To understand the applications of various software (HEC-HMS, HEC-RAS, etc) used in catchment hydrology

**Course Contents**

Hydraulics: (Flow in Open Channels) - Uniform flow - Introduction of flow in open channels. Chezy’s formula and Manning’s formula. Design of non-erodible channels. Non-uniform flow: The dynamic equations for gradually varied flow and their solution for some common problems. Rapidly varied flows: hydraulic jumps. Unsteady flow in open channels: Unsteady flow in rivers, canals, drainage channels etc. Analysis for flow through hydraulic structures viz spillways, weirs, sluices flumes. Energy control, wave motion and flow in non-prismatic channels. Hydrology: Meteorology - The basic concepts: Instrumentation and measurement of physical meteorological parameters viz solar radiation, wind, temperature, sunshine, pressure, rainfall, humidity, weather systems and climate. Hydrological Processes: The hydrological cycle and the water balance equation. Measurement and or estimation of the various components in the cycle i.e. precipitation, evapotranspiration, infiltration, surface runoff, groundwater, etc. Hydrograph Analysis: Components of hydrograph, base flow separation, volume of runoff estimation. Concept of unit hydrograph. Rainfall - runoff relationships: Models for rainfall runoff relationships viz: The rational formula, SCS curve number, etc

**BUK-CEE 407: Introduction to Transportation Engineering**

**(2 Units; Elective, LH = 30)**

**Senate-approved relevance**

Training of high-quality graduates who are highly skilled and knowledgeable in the design, operation construction, and maintenance of pavements are in agreement with BUK’s mission and visions to improve transportation systems in Nigeria and other African countries. This is in line with the current global practice and developments in developed countries. Applicability is shown in transportation engineers from BUK which are able to develop various techniques to improve the performances of different transportation systems so as to reduce the number of accidents and deaths trough road accidents.

**Course Overview**

Transportation is a basic human need; everyone travels either for food, leisure or other important reasons. A closely associated need is the transport of raw materials to a manufacturing unit or finished goods for consumption. Transportation fulfills these basic needs of humanity. Transportation plays a major role in the development of the human civilization. Also, it is well known that there is a strong correlation between the quality of transport facilities and standard of living, because of which society places a great expectation from transportation facilities. In other words, the solution to transportation problems must be analytically based, economically sound, socially credible, environmentally sensitive, practically acceptable and sustainable. These and other reasons highlights the significance and importance of training students in transportation systems with the knowledge and skills on how to design construct and maintain various transportation systems.

This course is designed to expose students to various modes of transportation systems and to educate them on how to improve on the current developments in different transportation systems. The objectives of the course, learning outcomes, and contents are provided to address this need.

**Course Objectives:**

1. Introduce students to fundamentals knowledge of transportation engineering.
2. Introduce students to the principles and practices of transportation engineering.
3. Introduce student to the role of transportation in modern societies and communities as well as roles of different modes of transportations.
4. To provide basic knowledge in transportation so that students can understand and be able to solve transportation related problems and design for highway mode of transportation with focus on highway users’ characteristics, geometric and pavement design, traffic engineering, and transportation planning.
5. Introduce students to emerging technologies in transportation as well as various career opportunities in transportation**.**

**Learning Outcomes**

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

1. Describe the role of transportation in modern societies and communities.
2. Explain different types of transportation systems available.
3. Describe the importance of transportation to the economy.
4. Explain the concept of emerging technologies in transportation
5. Identify importance and career opportunities in transportation

**Course Contents**

History and Development of transportation. Importance of transportation. Factors affecting transportation development. Economic, social, spatial, cultural and political impacts of Transportation. Types of transportation: land, air, and marine. Transportation system. Emerging technologies in transportation (Intelligent transportation system, smart mobility, logistics). Concept of sustainable transportation. Career opportunities in transportation engineering.

**BUK-CEE 501: Geotechnical Engineering (3 Units; Core, LH = 45; PH = 45)**

**Senate Approved Relevance**

This course is designed to provide the student with a level of understanding of design of various structures build from soil such as slope, embankment, foundation, etc. and such structures should not fail as a result of any misunderstanding or lack of knowledge about the nature of the soil conditions. This is in line with BUK’s mission of producing high quality graduates that can address African developmental challenges in producing civil engineering graduates

**Course Overview**

This course is meant to equip students with knowledge and skills necessary for planning and carrying out site investigation and use the ground model generated to design foundations and slopes.

The course also helps the students to be familiar with the geotechnical behavior and peculiarities of soils in this part of the world. The students will also benefit from this course by gaining insight on how to improve the engineering properties of problem soils.

**Course Objectives**

The objectives of this course are to:

1. equip students with knowledge and skills necessary for planning and carrying out site investigation
2. use the ground model generated to design foundations and slopes.
3. helps the students to be familiar with the geotechnical behavior and peculiarities of soils in this part of the world.
4. benefit from this course by gaining insight on how to improve the engineering properties of problem soils.

**Learning Outcome**

At the end of this course the students are expected to be able to:

1. Be familiar with the key steps involved in site investigation, and understand the applications and limitations of a wide range of methods available for sub-surface profiling as well as acquire the skill of planning and reporting site investigation.
2. Understand the behaviour of shallow foundations at the brink of failure, solve simple foundation capacity problems using bearing capacity equation and design shallow foundations within a limit-state design framework based on shear strength parameters and in-situ test data.
3. Understand the principles on which piles behave, their variety and the advantages they offer over shallow foundations as well as analyse their carrying capacity when they are installed as mono-piles or as a group.
4. Analyse the stability of slopes and embankments and have a good grasp of the methods of slope stabilization.
5. Understand the circumstances where ground improvement is required, to be familiar with various techniques of ground improvement and understand the criteria for selecting suitable method of improvement.

**Course Contents**

Site investigation: Introduction - Objectives of site investigation; site investigation stages – desk study; site reconnaissance. Ground investigation - Methods of ground exploration – Pit excavation, drilling, in-situ techniques, geophysical methods. Soil Sampling – types of sampling, frequency of sampling, borehole layout and spacing. Site investigation report - Guidelines for preparing site investigation report; format of report; case studies. Tropical soils - Identification, classification and geotechnical properties of tropical soils (special preferences to Nigeria). Shallow foundations: Types of shallow foundations; modes of failure in shallow foundations. Definitions of bearing capacity; estimation of bearing capacity of shallow foundations using Terzaghi’s equations; General equations for bearing capacity; effects of ground water, load eccentricity and inclination on bearing capacity; Bearing capacity estimation based on in-situ tests. Deep foundations (piles): Types of pile; methods of pile installation; pros and cons of pile types. Mechanism of load transfer in piles; ultimate capacity of piles in cohesive and non-cohesive soils. Pile installed in fills; negative skin friction. Pile groups capacity and efficiency. Tension piles and anchors. Stability of slopes: Types of slope, Stability of infinite slopes; effect of seepage on slope stability, Stability of finite slopes; Taylor’s chart; Method of slices; Swedish method, Bishops simplified method. Slope stabilization methods.

**BUK-CEE 506: Traffic Engineering (3 Units; Core, LH = 45; PH=45)**

**Senate-approved relevance**

To train and produce high quality graduates with adequate knowledge and skills in planning, design, and operational performance assessment of highway facilities. To also have sufficient knowledge and skills in design and operation of traffic management and control systems for different modes of transportation aimed at smooth traffic flow with minimum potential for traffic accidents, reliable and sustainable transport for different modes.

**Course Overview**

This course will expose students to the fundamental theory of traffic engineering. The course provides students with sound knowledge of driver’s behavior and vehicle characteristics and their consideration in design of highway facilities. It will also provide the students with the fundamental of traffic flow theory, concept of speed–flow–density relationships and applications in highway performance analysis. Further, it will equip the students with adequate knowledge and skills in conducting various traffic studies, with emphasis on data collection techniques, data analysis, interpretation and their applications to solve traffic problems. The course is also designed to expose the students to the design of traffic signal control system for highways. It will also equip the students with appropriate techniques used for traffic management and control for various modes of transportation such as highways, railways and airways.

**Course Objectives**

The objectives of the course are to:

1. Equip the student with adequate knowledge of driver’s behavior and vehicle characteristics as key influencing factors in highway design.
2. Apply the fundamentals of traffic flow theory to evaluate traffic stream characteristics and solve traffic problems.
3. Conduct various traffic engineering studies using appropriate data collection and analyses methods. To interpret the findings and apply them to solve traffic problems.
4. Evaluate the operational performance of highway facilities, highlights the problems (if any) and provides solution for improved performance of the facilities.
5. Equip the students with management and control approaches for different modes of transportation.

**Learning outcomes**

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

1. Describe the driver, vehicle and road characteristics, their interactions as they affect highway design and operation. To apply their characteristics in highway design and performance assessment.
2. Appreciate the fundamental traffic variables and their relationships.
3. Measure, analyse traffic stream variables and apply them to solve traffic problems.
4. Explain the operational performance of highways segment and evaluate the facilities performance based on their measures of effectiveness.
5. Describe and analyse road segments and intersection capacities, estimate their LOS and their applications in traffic management.
6. Conduct travel time and delay studies at segments and intersections, analyse the data and apply them to solve problems.
7. Understand the need for parking, parking demand and supply, conduct parking surveys in urban areas and design parking lots.
8. Explain and identify congestion features, associated problems, analyse the problems and offer solutions.
9. Describe the different approaches of highway, railway and airway traffic control; analysis and design of traffic signal system, use of other traffic control devices; markings, and signalling.
10. Explain the concept of ITS application in traffic management and control.

**Course Contents**

Driver, vehicle and road characteristics. Traffic flow theory: Types of traffic flow; interrupted and uninterrupted flow, Traffic flow variables; traffic volume, flow rate, speed, density, time & distance headways, time-mean speed and space-mean speed. Speed-Flow-Density relationships, fundamental diagram of traffic & their applications. Measurement and analysis of traffic flow parameters: (a) Speed; spot speed, journey speed, running speed, overall speed, and design speed. Applications of speed data; speed limits, control and enforcement. (b) Volume: Traffic count methods; manual and automatic counts, vehicle classifications, AHV, ADT, AADT and DHV, determination of peak and off-peak volumes (periods) and their applications. Traffic composition; PCE and their applications in traffic analysis. (c) Density: Density from other variables; spacing, headway and flow rate. Operational performance of highway segments; two-lane & multilane highways, & freeways. Performance measures of highway segments. Capacity and level of service (LOS) of highway segments and intersections. Travel time and delay studies: Road segments and intersections. Parking analysis: Types, parking configuration, parking demand & supply, and parking surveys. Congestion on highway facilities; types, causes & amelioration. Management of congestion; administrative and planning actions to prevent or mitigate congestion. Traffic Control of Transportation Modes: (a) Road Traffic Control Devices: Traffic signal operation & design: Traffic signal head, advantages & disadvantages, types of traffic signal, traffic signal design using Webster method, coordination of traffic signal system. Traffic signs, pavement markings & their configurations. (b) Rail Signalling: Railway traffic & control, and signaling systems; Classification of signals, description of different of signals classes. (c) Air traffic control (ATC): Introduction, functions of ATC, ATC network. (d) Application of ITS in traffic management and control.

**Laboratory Practical**

Traffic volume study; classified volume count, traffic composition and estimation of AHV, ADT and AADT in vehicles and PCE. Determination of peak and off-peak periods. Speed measurements; spot speed and journey speed. Performance assessment of highway segments and intersections based service measures; PTSF, ATS, Density, Flow rate, and Saturation flow. Determination of traffic signal optimum cycle and green times for phases. Parking demand study.

Field trip to observe and understand the signal system facility for railway and airway traffic operations/control.

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

To understand the driver, vehicle and road characteristics, their interactions as they affect highway design and operation. To apply their characteristics in highway design and performance assessment. Appreciate the fundamental traffic variables and their relationships. Measure, analyse traffic stream variables and apply them to solve traffic problems. Understand the fundamental operational performance of highways segment and evaluate the facilities performance based on their measures of effectiveness. Understand and analyse road segments and intersection capacities, estimate their LOS and their applications in traffic management. Conduct travel time and delay studies at segments and intersections, analyse the data and apply them to solve problems. Understand the need for parking, parking demand and supply, conduct parking surveys in urban areas and design parking lots. Understand and identify congestion features, associated problems, analyse the problems and offer solutions. Understand the different approaches of highway, railway and airway traffic control; analysis and design of traffic signal system, use of other traffic control devices; markings, and signalling. Understand the application of ITS in traffic management and control.

**BUK-CEE 503: Structural Analysis III (3 Units; Core, LH = 45 PH 45)**

**Senate Approved Relevance**

Developing technical knowledge and skills in analyzing complex structural systems is key in producing quality civil/structural engineering graduates who are highly skilled and knowledgeable in the design and analysis of structures, evaluation, planning and creative design abilities that can contribute to the developmental need of Nigeria. The course is very relevant in this regard and is in-line with the mission and vision of Bayero University, Kano.

**Course Overview**

This course is aimed at deepening students understanding and skills in analyzing indeterminate beams and frames under varied loading conditions including sway and support displacements.

**Course Objectives**

The objectives of the course are to:

1. Advance the skills acquired in analysis of beams and frame systems using varied analytical approaches
2. Introduce students to matrix and finite element analyses approaches
3. Advance slab analyses using the yield line method
4. Introduce finite difference method in analysis of structural elements and systems

**Learning Outcome**

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

1. Analyse indeterminate frame structures including sway and differential vertical displacements.
2. Determine vertical and lateral load effects on indeterminate beams and frames using Kani’s, Slope-Deflection and Moment-Distribution Methods.
3. Determine load effects on indeterminate beams and frames using flexibility and stiffness matrix methods
4. Apply numerical (finite element and finite difference) methods in analyses of structures
5. Appreciate dynamic loadings and analysis of structure.

**Course Contents**

Analysis of indeterminate frame structures (including sway and differential vertical displacements) using Slope-Deflection Method, Kani’s Method and Moment Distribution Method. Flexibility method of analysis of beam and frame structures. Stiffness (Matrix) Method of Analysis. Analysis of slabs using yield line and strip methods. Application of Finite Difference in structural analysis.

**BUK-CEE 504: Design of Reinforced Concrete Structures II**

**(3 Units; Core, LH = 45 PH 45)**

**Senate Approved Relevance**

Advancing teaching of design of reinforced concrete structures place graduates of Bayero University ahead in contributing in the provision of stable and cost-effective building structures in Nigeria. The course strengthens the knowledge acquired at lower levels and adequately prepares the students to be self-reliant which is consonance with the mission and vision of Bayero University, Kano.

**Course Overview**

The aim of this course is to prepare and equip students with skills for design of full scale reinforced concrete building and other structures.

**Course Objectives**

The objectives of the course are to:

1. Strengthen understanding of material characteristics of the concrete-steel composite
2. Deepen understanding of theorems, load estimation and basic equations for the design of structural elements against flexure, shear, torsion, deflections etc.
3. Advance knowledge on the use of codes and standards in design of reinforced concrete elements
4. Teach design of slab, beams, columns and foundation of building structures
5. Apply analytical skills acquired in structural design of a typical architectural design for building and other infrastructural designs as a design project by each student

**Learning Outcome**

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

1. Deeply use British and/or Euro-codes as well as any Nigerian/National code in the design of civil-structural infrastructures.
2. Quantify live (imposed) and dead (self-weight) loadings for buildings and other structures
3. Understand and design different types of slabs for serviceability and ultimate limit states
4. Understand and apply the different slab load transfer methods to beams
5. Design structural elements against flexure, punching and general shear, torsion, compression etc.
6. Apply analytical skills acquired in the analysis and designs of structural elements in accordance with approved standard.

**Course Contents**

Review of limit state design methods. Detail design of reinforced concrete structures to a National or International Standard/code (Nigerian or British or Eurocode standards). Loadings, analyses and design of reinforced concrete solid, ribbed and waffle slabs as well as longitudinally and transversely analysed staircases. Loadings, analyses and design of beams. Loadings analysis and design of columns and walls. Design of RC retaining walls and specialized structures. Loadings, analysis and design of foundations. Design projects.

**BUK-CEE 504: Water Resources Engineering (2 Units; Core, LH = 45; PH = 45)**

**Senate Approved Relevance**

Production of high-quality water engineers that can use local hydrologic data of Kano region and beyond to plan, design, supervise and maintain water resources projects such as water storage facilities, water conveyance structures as well as water supply infrastructure that can operate in a semi-arid region of Kano and other regions

**Learning Outcome**

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

1. To estimate flood of different return periods using statistics and probability concepts
2. To calculate flood using reservoir routing technique
3. To calculate flood using channel routing technique
4. To design urban stormwater drainage systems
5. To analyze groundwater flows through confined and unconfined aquifer
6. To analyze flows towards wells drilled in confined and unconfined aquifer
7. To determine aquifer constants from pumping test ie: Storativity and transmissivity
8. To design embankment dams
9. To design gravity dams
10. To know different types of spillways, energy dissipation techniques, outlets works, etc
11. To know the various terms used in relation to reservoir operations
12. To determine storage capacity and yield of a reservoir

**Course Contents**

Frequency Analysis: Statistics and probability methods in hydrology, Use of models such as Normal, Log-normal, Gumbel, Log-Pearson Type III, etc for hydrological forecasting. Hydrologic Flood Routing: Level pool (Reservoir) routing and Muskingum’s (Channel) routing. Urban Hydrology: Design of urban stormwater drainage systems. Groundwater Hydraulics: Hydraulics of flow through confined and unconfined aquifer. Well hydraulics. Ground water exploration. Hydraulic Structures: Design of earth dams, rock fill dams, concrete dams and associated components e.g., spillways, stilling basing, outlet works, sluice ways etc. Functional design of service and impounding reservoirs. Sedimentation control in reservoirs.

**BUK-CEE 505: Public Health Engineering (3 Units; Core, LH = 45; PH = 45)**

**Senate approved relevance**

Bayero University aims to produce graduates that work to advance the well-being of an ever-growing cities like Kano, SDG No. 6 specifically addresses water and sanitation issues. In sub-Saharan Africa cities, there is risk to public health from lack of clean water, hygiene and sanitation. The course aims to connect the relation between public health, water supply and wastewater treatment and re-use. Likewise, the course aims to equip students with skills in design of water and wastewater treatment systems as well as solid waste management and air pollution mitigation strategies.

**Learning Outcome**

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

1. Understand the basics of public health and the role of the sanitary engineer in promoting and protecting public health
2. Recognise the direct link between various uses of water and water-related diseases, especially with reference to excreta-related diseases
3. Have sound understanding of unit operations and processes in water and wastewater treatment
4. Be able to design the stages in conventional water treatment and wastewater treatment, particularly paying attention to the appropriateness of the chosen technology
5. Understand *traditional solid waste management* and *integrated solid waste management* practices while appreciating the strength of the latter over the former
6. Demonstrate an understanding on the basic principles of air pollution and the various options for the control of air pollution

**Course Contents**

Water and Wastewater Quality: The work of the Sanitary Engineer. Physical, chemical and biological characteristics of water and wastewater. Water quality and public health. Water pollution control. Water and wastewater treatment: Design of water treatment system; Unit operations, processes for the design of water treatment systems: Physical screening, sedimentation, flocculation, coagulation, filtration & disinfection. Wastewater collection, treatment, disposal and design of systems such as waste stabilization ponds, aerated lagoons, etc. Appropriate technology of water and wastewater treatment. Solid Waste Management: Solid waste characterization, collection, treatment, disposal and design of systems such as sanitary landfill, etc. Air pollution and control. Definition of air pollution. Particulate pollution and their sources, effects on weather, vegetation, materials and human health. Legislation relating to air pollution, methods of controlling and destruction of gaseous emissions: use of cyclones, inertia separators, electrostatic precipitators, bag filters, wet washers, etc. Dispersal from chimneys and methods of calculating chimney height and flare stacks.

**BUK-CEE 506: Transportation Planning (2 Units; E, LH = 30)**

**Senate-approved relevance**

Training of civil engineering graduates who are highly equipped with knowledge and skills in Transportation Planning and Public Transport System. Our students will be able to offer integrated solutions by balancing policy, investments, technology, and land use. These aim to support long-term growth and strategic accessibility in the midst of limited budget available due to competing sectoral demand. In this regard, BUK graduates will be ready to utilize the opportunities offered by the emerging transportation trend under the Interstate Rail Systems, Bus Rapid Transit, Urban Light Rail Systems and Rural Road Infrastructure currently at early stage of development in Nigeria.

**Overview**

Transportation planning is the process of looking at the current state of transportation in the region, designing for future transportation needs, and combining all of that with the elements of budgets, goals and policies. It is a prediction of usage demand in future travel and to ensure all the necessary facilities and services to cater to that demand. Under Transportation Planning the process of defining future policies, goals, investments, and spatial planning designs to prepare for future needs to move people and goods to destinations is addressed. Transportation planners apply a multi-modal and/or comprehensive approach to analyzing the wide range of alternatives and impacts on the transportation system to influence beneficial outcomes. Transportation planning is also commonly referred to as transport planning internationally, and is involved with the evaluation, assessment, design, and siting of transport facilities (generally streets, highways, bike lanes, and public transport lines). Transport planning is highly essential in shaping cities, enabling economic activities, promoting community interaction, and enhancing quality of life. It is also essential for sustainable development and ensuring safe accessibility at various levels for all individuals.

**Learning Outcome**

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

1. To have knowledge of the urban transportation planning process
2. To have knowledge of the structure transportation planning models
3. Build a system description of a transportation network.
4. Set up simple operational models.
5. Apply different types of models for the estimation of the transportation demand.
6. Interpretation of the model results.
7. Working with applications/software for transportation estimations.
8. Understand public transport, analyse and evaluate its operation, highlights the problems and propose solutions for improvement.

**Course Contents**

Overview of land use theories in transportation. Transportation planning studies; transport planning surveys and data collection procedures. Models and their applications in transportation system analysis. Travel choice theory. Aggregated models for trip generation, distribution, model split and network assignment. Disaggregated choice models. Estimation of model parameters and calibration. Planning and appraisal of rural road projects (Application of basic tools: HDM4, RED etc.). Planning of public transport system; urban public transport, public transport modes, characteristics and prospects.

**BUK-CEE 507: Analysis and Design of Timber Structures (2 Units; Elective, LH = 30)**

**Senate Approved relevance**

This course will help to develop knowledge and skills of students for practical solutions in construction of buildings and other structures using timber materials that are in abundance in Nigeria. The ability to develop and implement design of timber structures will help in a great way in finding cost-effective alternative to low cost housing in Nigeria. This could also broaden the research base of the University, in this area, which is in tandem with the mission and mission of Bayero University, Kano.

**Course Overview**

This course is aimed at introducing and deepening students understanding in design of timber structures.

**Objectives**

The objectives of the course are to:

1. Present basic mechanical properties of timber and seasoning approaches necessary for their durability.
2. Understand the stress grades of timber based on both local and international standards.
3. Design timber elements and systems using both permissible and limit-state design methods
4. Design of structures using compound and synthetic timbers
5. Connection design using glues, nails, bolts etc. for varied connection conditions

**Learning Outcome**

1. Understand the basic properties of timber, stress grading and the various defects associated to the materials
2. Develop skills for timber seasoning and improved mechanical properties
3. Design timber structures using permissible and limit states principles for load effects of flexure, deflection, shear, bearing and compression.
4. Design of plywood decks, compound and glulam beams and columns as well as connections under combined axial and bending stresses
5. Apply analytical skills acquired in the analysis and designs of structural elements in accordance with approved standard

**Course Contents**

Basic properties of timber, defects and seasoning. Stress-grading of timber and engineering properties of Nigerian and foreign solid timbers. Application of permissible stress design philosophy in design of solid, compound and glulam beams under varied failure modes. Application of limit state design philosophy in design of solid, compound and glulam beams under varied failure modes. Analysis and design of plywoods decks. Analysis and design of solid, compound and glulam columns. Connection of timber elements under axial and combined axial and bending stresses using nails and bolts.

**BUK-CEE 508: Pre-stressed Concrete Design (2 Units; Elective, LH = 30)**

**Senate Approved relevance**

Developing high strength concrete for design and construction of specialized and complex civil engineering infrastructure is essential in fast tracking development and modernizing Nigerian cities for tourist attraction. This course will help to develop knowledge and skills of students in the production of pre-stressed concrete, its analyses and use in design of bridges and other special structure. The ability to develop, analyse and implement design of pre-stressed structures will help in a great way in finding cost-effective alternative to esthetic and gigantic structures in Nigeria. This will also broaden the research base of the University which is in tandem with the mission and mission of Bayero University, Kano.

**Course Overview**

This course is aimed at introducing and deepening students understanding in production analyse and design of pre-stressed concrete elements and systems.

**Objectives**

The objectives of the course are to:

1. Present basic difference between normal and pre-stressed concrete
2. Understand established pre-stressed design philosophy
3. Estimate pre-stress force and loss of pre-stressed on structural elements
4. Teach and demonstrate analyses and design of pre-stressed structures under bending, shear, compression of structural elements under varied support conditions

**Learning Outcome**

1. Understand Prestressed concrete design philosophy; Presstressing systems; Loss of prestressed
2. Understand the basic properties pre-stressed concrete material
3. Develop skills for analyses and design of pre-stressed concrete elements and systems
4. Understand factors leading to loss of pre-stress and estimate of same in structural elements and systems.
5. Apply analytical skills acquired in the analysis and designs of structural elements in accordance with approved standard

**Course Contents**

Prestressed concrete design philosophy; Presstressing systems; Loss of prestressed; Analysis and design of prestressed concrete sections in bending, shear, bond and bearing; Partial pre-stress and non-prestress reinforcement; Design of compression members. Design project.

**BUK-CEE 509: Rock Mechanics (2 Units; Elective, LH = 30)**

**Course Overview**

The course is aim at equipping the students with related knowledge and principles in rock mechanics, and should be able to apply these knowledge and principles in designing safe and economic engineering structures in rock masses.

**Objectives**

**Learning Outcome**

1. Understand the function of rock as foundation.
2. Appreciate the function of rock as construction material
3. Analyse and design foundations on rocks
4. Identify various methods of rock exploration.

**Course Contents**

Rock as a foundation and constructional materials, engineering properties of rocks. Engineering behaviour of rock masses and classification of weathered rocks and rock masses. Improvement of rock engineering properties. Foundation on rocks – bearing capacity – foundation of buildings, industrial structures, roads and railway, tunnels and hydraulic structures. Exploration of rocks, reconnaissance, surface investigations, in-situ testing of rocks. Rock slope stability.

**BUK-CEE 510: Irrigation and Drainage Engineering (2 Units; Elective, LH = 30)**

**Senate Approved Relevance**

Rainfed agriculture is mostly insufficient to feed the ever growing population of sub-Saharan arid regions like Kano, etc. The course is aimed at training high quality irrigation engineering experts, that can handle design, construction and maintenance of irrigation facilities

**Learning Outcome**

1. To understand the significance of phase relationship of soil in relation to irrigation
2. To understand the significance of soil moisture contents (field capacity, wilting point, etc) to plants
3. To know the classification and agronomy of some selected tropical crops
4. To be able to estimate crop water requirements
5. To be able to design surface and sub-surface irrigation systems
6. To be able to design irrigation water conveyance systems
7. To know the significance of soil salinity to crops and need for soil drainage
8. To design various soil drainage systems.

**Course Contents**

Soil water-plant Relations: Physical properties of soil and water; water retention and availability in soils; soil water movement; crop-water relations; salinity; evapo-transpiration and crop water requirements.

Crop Production: Basic introduction to crop classification; environmental crop physiology and crop agronomy of selected tropical crops. Irrigation Irrigation need; irrigation methods - furrow, border, ponding etc; design of surface, sprinkler and trickle irrigation systems; land grading on farm and scheme water requirements; scheduling and managing the distribution of water; design of canals.

Drainage: Drainage need for both humid and irrigated land; drainage design theories; drain spacing and depth requirements for humid, humid-irrigated and dry irrigated areas; methods and materials; system monitoring, problem soils.

Design and installation of surface, sub-surface, pipe and mole drainage systems; drain maintenance.