COURSE LEARNING OUTCOMES (CLOs)

100 Level

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

Learning Outcomes:

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

1) Identify possible sound patterns in English Language;
2) List notable language skills;
3) Classify word formation processes;
4) Construct simple and fairly complex sentences in English;
5) Apply logical and critical reasoning skills for meaningful presentations;
6) Demonstrate an appreciable level of the art of public speaking and listening; and
7) Write simple and technical reports.

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

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

Learning Outcomes:

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

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

8) list possible solutions to identifiable Nigerian environmental, moral and value problems.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

6) analyse the data to arrive at scientific conclusions.

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

CHM 108: General Practical Chemistry II (1 Unit C: PH 45)
Learning Outcomes
At the end of this course, the students should be able to:

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

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

MTH 101: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
Learning Outcomes
At the end of the course students should be able to:

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

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

On completion, the students should be able to:

1) identify and deduce the physical quantities and their units;
2) differentiate between vectors and scalars;
3) describe and evaluate motion of systems on the basis of the fundamental laws of mechanics;
4) apply Newton’s laws to describe and solve simple problems of motion;
5) evaluate work, energy, velocity, momentum, acceleration, and torque of moving or rotating objects;
6) explain and apply the principles of conservation of energy, linear and angular momentum;
7) describe the laws governing motion under gravity; and
8) explain motion under gravity and quantitatively determine behaviour of objects moving under gravity.

Course Contents

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

moments of inertia, gyroscopes and precession; gravitation: Newton's law of gravitation, Kepler's laws of planetary motion, gravitational potential energy, escape velocity, satellites motion and orbits.

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

Learning Outcomes

On completion, the students should be able to:

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

Course Contents

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

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

Learning Outcomes

On completion, the student should be able to:

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

Course Contents

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

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

Learning Outcomes

On completion, the student should be able to:

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1) have a good grasp of design thinking and be obsessed with the determination to apply such to solving simple every day and also complex problems;
2) recognise the fundamental concepts of engineering drawing and graphics;

3) show skills to represent the world of engineering objects in actionable solid models, and put such models in a form where they can be inputs for simulation and analyses;
4) analyse such models for strength and cost;
5) prepare the objects for modern production and manufacturing techniques of additive and subtractive manufacturing;
6) recognise that engineering is multidisciplinary in the sense that mechanical, electrical and other parts of physical structures are modelled in context as opposed to the analytical nature of the courses they take; and
7) analyse and master the basics of mechanical and thermal loads in engineering systems.

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

CEE 101: Introduction to Civil Engineering (1 Unit C: LH 15)
Learning Outcomes
Upon the successful completion of this course, students should be able to:
1) explain the profession of civil engineering and
2) the roles played by civil engineers.

Course Contents
History of civil engineering. Branches of civil engineering. Roles of civil engineers in government, industry and academia. Allied professionals and their interaction with civil engineers. Career opportunities in civil engineering, professional and regulatory bodies.

200 Level

GST 212: Philosophy, Logic and Human Existence (2 Units C: LH 30)
Learning Outcomes
At the end of the course, students should be able to:
1) know the basic features of philosophy as an academic discipline;
2) identify the main branches of philosophy & the centrality of logic in philosophical discourse;
3) know the elementary rules of reasoning;
4) distinguish between valid and invalid arguments;
5) think critically and assess arguments in texts, conversations and day-to-day discussions;

6) critically asses the rationality or otherwise of human conduct under different existential conditions;
7) develop the capacity to extrapolate and deploy expertise in logic to other areas of knowledge, and
8) guide his or her actions, using the knowledge and expertise acquired in philosophy and logic.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

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

Learning Outcomes

Students will be able to:

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

Course contents

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

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

Learning Outcomes

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

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

The course comprises general, mechanical and electrical components: supervised hands-on experience in safe usage of tools and machines for selected tasks; Use of measuring instruments (calipers, micrometers, gauges, sine bar, wood planners, saws, sanders, and pattern making). Machine shop: lathe work shaping, milling, grinding, reaming, metal spinning. Hand tools, gas and arc welding, cutting, brazing and soldering. Foundry practice. Industrial safety and accident prevention, ergonomics, metrology. Casting processes. Metal forming processes: hot-working and cold-working processes (forging, press tool work, spinning, etc.). Metal joining processes (welding, brazing and soldering). Heat treatment. Material removal processes. machine tools and classification. Simple theory of metal cutting. Tool action and cutting forces. Introduction to CNC machines. Supervised identification, use and care of various electrical and electronic components such as resistors, inductors, capacitors, diodes and transistors. Exposure to different electric circuits, wiring schemes, analogue and digital electrical and electronic measurements. Household and industrial energy consumption measurements. Practical energy conservation principles.

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

1) describe basic concepts of thermodynamics, quantitative relations of Zeroth, first, second and third laws;
2) define and explain system, surrounding, closed and open system, control volume and control mass, extensive and intensive properties;
3) calculate absolute and gage pressure, and absolute temperature, calculate changes in kinetic, potential, enthalpy and internal energy;

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

Course Contents

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

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

Learning Outcomes

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

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

6) evaluate the stresses and strains due to torsion on circular members; and
7) determine the buckling loads of columns under various fixity conditions at the ends.

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

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

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

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

Course Contents

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

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

Learning Outcomes

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

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

Course Contents

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

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

Learning Outcomes

SIWES I should provide opportunity for the students to:

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

Course Contents

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

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

CEE 201: Civil Engineering Drawing (2 Units E: LH 15; PH 45)

Learning Outcomes

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

1) capable of drawing and detailing (by hand and using computer-aided-design skills) civil engineering structures; and
2) identify building structures, highways, pipelines, bridges, dams, foundations and so on using appropriate symbols and conventions.

Course Contents

Drawing and detailing (by hand and using computer-aided-design skills) of civil engineering structures, for example building structures, highways, pipelines, bridges, dams, foundations, etc. utilizing standard symbols and conventions, dimensions, notes, titles, etc. Relationship to specifications.

LEVEL 300 COURSES
EGR3101 – Engineer in Society (2 Credit Units)
Short Description
Introduces the structure and function of business organizations, industrial combinations, public utilities, and finance. Covers government control of industries, economic planning and development in West Africa, the banking and capital markets, and the economic impacts of inflation, cost–benefit analysis, and structural adjustment programmes.

Key Topics
- Business organizations and industrial combinations
- Public utilities and finance
- Industrial concentration and government control
- Location and structure of West African industry and trade
- Economic background and planning in West Africa
- Financing development projects
- Banking system, money, and capital markets
- Inflation and cost–benefit analysis
- Structural Adjustment Programme (SAP)

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Explain the structure of business organizations, industrial combinations, and public utilities, and	Understand	PO6 (3), PO7 (2)	Understanding socio-economic and cultural contexts supports sustainable engineering solutions	Lectures, case studies	Quizzes, written exams

their relevance to engineering practice.			and societal awareness.		
CLO2:Analyse the impact of industrial concentration, government control, and economic policies on engineering projects.	Analyse	PO6 (3), PO7 (2), PO11 (2)	Engineers must assess economic and policy influences to ensure projects meet societal and sustainability needs.	Seminars, group discussions	Essays, project report
CLO3:Evaluate development financing options using cost–benefit analysis and economic indicators.	Evaluate	PO6 (2), PO11 (3)	Selecting and justifying project financing options aligns with cost-effectiveness and sustainability.	Lectures, workshops	Class tests, assignments
CLO4:Assess the role of banking systems, capital markets, and SAP in socio-economic development.	Evaluate	PO6 (3), PO7 (2)	Recognising the influence of financial systems enables engineers to align projects with economic realities.	Lectures, guest talks	Case study analysis

EGR3102 – Technical Writing and Presentation (2 Credit Units)
Short Description
Develops the ability to communicate technical ideas effectively in both written and oral formats. Covers professional use of English, principles of technical writing, and techniques for delivering clear, structured oral presentations of engineering content.
Key Topics

- Principles of effective communication
- Professional use of English for engineering
- Structure and style in technical writing
- Use of visuals and data in reports
- Oral presentation techniques for technical ideas
- Audience analysis and engagement

CLO–PO Mapping Table

CLO	Bloom's	Mapped POs	PO Justification	Teaching	Assessment Tools

	Level	(Contribution Level)		Methods	
CLO1:Apply principles of effective communication in technical contexts.	Apply	PO10 (3)	Engineers must convey ideas clearly to diverse audiences for effective professional practice.	Lectures, writing workshops	Written assignments, in-class tests
CLO2:Produce well-structured technical documents adhering to professional standards.	Create	PO10 (3)	Documentation supports design, implementation, and communication of engineering solutions.	Tutorials, peer review sessions	Technical reports, project documentation
CLO3:Deliver clear and engaging oral presentations of technical content.	Apply	PO10 (3)	Oral communication is essential for reporting, persuasion, and collaboration in engineering.	Presentation practice, seminars	Oral presentations, peer feedback
CLO4:Adapt communication style for different audiences and purposes in engineering.	Apply	PO10 (2)	Tailoring messages to audience needs improves stakeholder engagement and decision-making.	Group activities, role-play	Observations, participation scores

EGR3311 – Computer Applications (2 Credit Units)
Short Description
Introduces computer programming techniques, operating systems, data processing, and word processing applications relevant to engineering. Covers algorithms, flowcharts, BASIC and PASCAL programming, database management, and desktop publishing.
Key Topics

- Operating systems and programming concepts
- Algorithms, flow charts, pseudocode
- BASIC and PASCAL programming
- MS-DOS basics and batch files
- Data, metadata, database, DBMS, file types
- DBASE applications and macro programming
- Word processing and desktop publishing
- Numerical calculations and algorithms (sorting, searching, integration)

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Develop algorithms, flowcharts, and programs to solve engineering problems.	Create	PO5 (3), PO1 (2)	Computational skills support problem-solving in design and analysis.	Lectures, computer labs	Programming assignments, practical tests
CLO2:Apply database management and data processing concepts in engineering contexts.	Apply	PO5 (3), PO2 (2)	Organising and managing data ensures informed decision-making and accuracy.	Demonstrations, lab work	Lab reports, exercises
CLO3:Use word processing and desktop publishing tools for professional engineering documentation.	Apply	PO5 (2), PO10 (3)	Professional documentation is critical for presenting engineering outputs.	Tutorials, workshops	Document submissions, project reports
CLO4:Perform basic numerical computations using programming techniques.	Apply	PO1 (3), PO5 (2)	Applying numerical methods in programming strengthens engineering analysis.	Problem-solving sessions, labs	Code implementation tasks

EGR3301 – Engineering Mathematics (3 Credit Units)
Short Description
Covers advanced engineering mathematics topics including differential equations, partial differential equations, Laplace and Fourier transforms, and their applications in engineering problems involving heat transfer, wave propagation, and steady-state analysis.
Key Topics

- First and second order differential equations
- Higher-order linear equations with constant coefficients

- Partial differential equations (parabolic, hyperbolic, elliptic)
- Legendre and Hermite functions
- Boundary value problems
- Laplace and Fourier transforms and applications

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Solve first and higher-order differential equations relevant to engineering.	Apply	PO1 (3), PO2 (2)	Mathematical modelling is fundamental to engineering analysis and design.	Lectures, tutorials	Tests, exams
CLO2:Apply PDEs to model heat, wave, and steady-state problems.	Apply	PO1 (3), PO2 (3)	PDEs describe complex engineering systems for prediction and control.	Lectures, problem-solving	Assignments, problem sets
CLO3:Use Laplace and Fourier transforms to simplify and solve engineering problems.	Apply	PO1 (3), PO2 (2)	Transforms allow efficient analysis of systems in time and frequency domains.	Tutorials, workshops	Exercises, quizzes

EGR3302 – Computation Techniques (2 Credit Units)

Short Description

Focuses on numerical methods for solving engineering problems, including root finding, numerical integration/differentiation, eigenvalue problems, and solutions of ODEs. Introduces linear programming and computational algorithms.

Key Topics

- Linear and non-linear equations
- Finite difference operators
- Flow diagrams and charts
- Direct and iterative solutions for linear systems
- Numerical integration and differentiation (Newton-Coates)
- Linear programming basics
- Polynomial roots (bisection, Newton, Bairstow)
- Eigenvalue problems

- Numerical ODE solutions (Taylor, Euler, Predictor–Corrector, Runge–Kutta)

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Implement numerical methods to solve engineering problems.	Apply	PO1 (3), PO2 (3), PO5 (2)	Numerical methods enhance analytical capacity for engineering problem-solving.	Lectures, lab work	Problem sets, code exercises
CLO2:Construct computational algorithms and flowcharts for problem-solving.	Create	PO5 (3), PO1 (2)	Algorithm design supports logical reasoning and computational efficiency.	Tutorials, computer labs	Algorithm design tasks
CLO3:Apply linear programming techniques to basic optimization problems.	Apply	PO2 (3), PO1 (2)	Optimization skills improve design efficiency and resource utilisation.	Lectures, practical exercises	Tests, assignments

CIV3301 – Principles of Construction (3 Credit Units)

Short Description

Covers the principles and procedures of civil engineering construction, including the functions of the profession, design–construction interactions, general considerations for site work, and elements of construction across building, transportation, and hydraulic structures. Emphasises the role of appropriate technology in sustainable civil engineering practice.

Key Topics

- Definition and functions of the Civil Engineering profession
- Design and construction teams
- Influence of erection procedures on design
- Operation and maintenance of civil works
- Site investigation and organisation
- Temporary works and earthworks
- Construction machinery and equipment
- Domestic, industrial, and multi-storey building construction
- Foundations, floors, walls, staircases, roofs, frames
- Road works, subways, railways, airfields

- Hydraulic structures, dams, harbours, docks, jetties
- Dredging, reclamation, irrigation, and river works
- Pipelines for water, gas, and sewage
- Appropriate technology in construction

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Describe the functions of the civil engineering profession and the role of design–construction teams.	Understand	PO6 (3), PO7 (2)	Builds awareness of societal, environmental, and professional responsibilities.	Lectures, case studies	Quizzes, short-answer tests
CLO2:Analyse the influence of construction procedures on design and maintenance of facilities.	Analyse	PO1 (2), PO2 (3), PO11 (2)	Links practical construction approaches to design optimisation and sustainability.	Lectures, site visits	Assignments, project reports
CLO3:Explain general site considerations including investigation, organisation, and temporary works.	Understand	PO1 (3), PO3 (2)	Understanding site conditions ensures safety, efficiency, and quality in project delivery.	Lectures, demonstrations	Written tests, site reports
CLO4:Evaluate construction methods for various civil works and recommend appropriate technologies.	Evaluate	PO2 (3), PO7 (2), PO11 (2)	Selection of methods impacts project efficiency, safety, and sustainability.	Group work, seminars	Case study analysis, presentations

CIV3302 – Civil Engineering Materials (3 Credit Units)

Short Description

Explores the properties, types, manufacture, and uses of major civil engineering materials including cement, concrete, aggregates, ceramics, polymers, bituminous materials, and steel. Covers quality control, testing, durability, and applications in construction.

Key Topics

- Cement: manufacture, types, uses, properties
- Aggregates: sources, properties, uses

- Admixtures: sources, types, uses
- Concrete: types, properties of fresh/hardened concrete, design mixes, quality control
- Non-destructive testing, creep, shrinkage, durability
- Ceramic materials: clay products, glass, bricks
- Polymers: classification, manufacture, properties, applications
- Bituminous materials: manufacture, properties, uses, tests, road applications
- Steel technology: production, types, corrosion prevention, tests, quality control

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Identify the properties, classification, and applications of major construction materials.	Understand	PO1 (3), PO2 (2)	Knowledge of materials is essential for appropriate design and application.	Lectures, demonstrations	Tests, quizzes
CLO2:Analyse the performance of materials under different environmental and loading conditions.	Analyse	PO1 (3), PO2 (3), PO7 (2)	Ensures safety, durability, and sustainability in construction.	Lab work, tutorials	Lab reports, assignments
CLO3:Apply quality control methods and testing techniques to assess materials.	Apply	PO5 (3), PO1 (2)	Testing guarantees compliance with specifications and standards.	Practical demonstrations, labs	Practical tests, quality reports
CLO4:Evaluate materials for suitability in specific civil engineering projects.	Evaluate	PO2 (3), PO7 (2), PO11 (2)	Material selection influences project performance and life-cycle costs.	Case studies, discussions	Written reports, presentations

CIV3303 – Fluid Mechanics II (3 Credit Units)

Short Description

Covers advanced fluid mechanics including momentum principles, boundary layer theory, dimensional analysis, hydraulic machinery, and open channel flow. Focuses on practical engineering applications in pipelines, channels, pumps, and turbines.

Key Topics

- Momentum equation applications
- Boundary layer theory, eddies, skin friction, drag
- Dimensional analysis: Rayleigh method, Buckingham Pi theorem
- Turbines: Pelton, Francis, axial flow; characteristics, efficiencies
- Pumps: reciprocating and rotodynamic types, specific speed, efficiencies
- Flow in open channels: non-uniform, unsteady, erodible and non-erodible channels

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Apply momentum and energy equations to solve fluid flow problems.	Apply	PO1 (3), PO2 (3)	Fundamental for designing hydraulic systems and predicting performance.	Lectures, problem-solving	Assignments, quizzes
CLO2:Analyse fluid machinery performance using velocity diagrams and efficiency measures.	Analyse	PO1 (3), PO2 (3), PO5 (2)	Enhances capability to select and optimise hydraulic equipment.	Tutorials, labs	Lab tests, reports
CLO3:Use dimensional analysis to derive relationships in fluid flow problems.	Apply	PO1 (3), PO2 (2)	Enables modelling and scaling of fluid systems.	Lectures, exercises	Problem sets, exams
CLO4:Design open channels considering flow type and erosion potential.	Create	PO2 (3), PO7 (2)	Prevents failure, improves efficiency, and minimises environmental impact.	Design studios, discussions	Design reports, oral defence

CIV3304 – Soil Mechanics I (3 Credit Units)

Short Description

Introduces the classification, properties, and behaviour of engineering soils. Covers phase relationships, seepage and permeability, shear strength, effective stress, and stress–displacement analysis for geotechnical applications.

Key Topics

- Soil classification (grain size, Atterberg limits)

- Phase relationships: void ratio, porosity, density, specific gravity
- Seepage and permeability; flow nets
- Shear strength and Mohr–Coulomb criterion and Shear strength testing
- Effective stress principle, Stress distribution in soils and Displacement using influence charts

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Classify soils based on physical and index properties.	Understand	PO1 (3), PO2 (2)	Soil classification is essential for predicting engineering behaviour.	Lectures, labs	Lab reports, quiz
CLO2:Analyse seepage and permeability in soils using flow nets.	Analyse	PO1 (3), PO2 (3)	Determines design parameters for geotechnical and hydraulic works.	Tutorials, problem-solving	Assignments, tests
CLO3:Evaluate shear strength parameters using Mohr–Coulomb theory.	Evaluate	PO1 (3), PO2 (3)	Shear strength governs stability and safety of soil structures.	Labs, case studies	Test, Exams
CLO4:Apply effective stress concepts to solve stress distribution problems.	Apply	PO1 (3), PO2 (2)	Effective stress is critical to foundation and slope stability design.	Lectures, tutorials	Problem sets, exams

CIV3307 – Design of Structural Elements I (3 Credit Units)

Short Description

Introduces the fundamentals of reinforced concrete design, including analysis of frames, bending, shear, torsion, deflection, and cracking.

Key Topics

- Design theories and materials
- Analysis of frames for vertical and lateral loads
- Bending of reinforced concrete sections
- Shear, bond, and torsion behaviour
- Deflection and cracking control

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Analyse reinforced concrete frames under various loading conditions.	Analyse	PO1 (3), PO2 (3)	Frame analysis is fundamental for structural safety.	Lectures, problem-solving	Design assignments, quizzes
CLO2:Design sections for bending, shear, and torsion.	Create	PO2 (3), PO3 (2), PO5 (2)	Ensures adequate capacity and serviceability.	Tutorials, design studios	Design projects, exams
CLO3:Check deflection and cracking against serviceability limits.	Apply	PO2 (3), PO3 (2)	Maintains structural integrity and durability.	Case studies, calculations	Reports, assignments

CIV3308 – Strength of Materials (3 Credit Units)

Short Description

Covers advanced bending, shear, deflection, unsymmetrical bending, stress analysis, energy methods, creep, fatigue, fracture, and stress concentrations in structural elements.

Key Topics

- Advanced bending moment and shear force
- Theory of bending, deflection, and shear centre
- Unsymmetrical bending
- Biaxial stresses, Mohr's circle
- Energy methods (Castigliano, Betti, Maxwell)
- Creep, fatigue, fracture mechanics
- Stress concentration

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Analyse stresses and	Analyse	PO1 (3), PO2 (3)	Core skill for safe	Lectures, tutorials	Assignments,

deflections in beams under complex loading.			structural design.		quizzes
CLO2:Apply energy methods to determine displacements.	Apply	PO1 (3), PO2 (2)	Useful for complex and indeterminate structures.	Problem-solving, demonstrations	Problem sets, exams
CLO3:Evaluate the effects of creep, fatigue, and stress concentration.	Evaluate	PO1 (3), PO7 (2)	Critical for predicting service life and safety.	Case studies, lectures	Written reports, tests

CIV3309 – Structural Analysis I (3 Credit Units)
Short Description
Focuses on the analysis of determinate structures, including beams, frames, and arches, using analytical and graphical methods.
Key Topics

- Analysis of determinate beams
- Bending moment, shear force, axial force diagrams
- Graphical methods for reactions and resultants
- Section properties determination
- Simple frame and arch analysis

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Draw bending moment, shear force, and axial force diagrams.	Apply	PO1 (3), PO2 (3)	Provides basis for member design.	Tutorials, lectures	Assignments, tests
CLO2:Use graphical methods to determine reactions and forces.	Apply	PO1 (3), PO2 (2)	Enhances visualisation and verification skills.	Demonstrations, exercises	Problem sets, quizzes
CLO3:Analyse simple frames and arches.	Analyse	PO1 (3), PO2 (3)	Essential for structural stability assessment.	Lectures, problem-solving	Exams, assignments

CIV3401 – Engineering Geology (3 Credit Units)

Short Description
Introduces geological principles relevant to civil engineering, including earth structure, geological processes, mineralogy, petrography, mapping, geophysical techniques, and geological applications in the design and construction of engineering works.

Key Topics

- Relevance of geology to civil engineering
- Structure and surface processes of the earth
- Weathering, erosion, transportation, deposition
- Soil formation processes
- Mineral types and properties
- Rock types and properties
- Geological structures and mapping
- Geophysical methods
- Stratigraphy and fossils (with Nigerian context)
- Geology of Nigeria
- Engineering applications: dams, tunnels, slopes, groundwater

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Explain geological processes and their impact on civil engineering projects.	Understand	PO7 (3), PO6 (2)	Helps anticipate and mitigate geological hazards.	Lectures, case studies	Quizzes, assignments
CLO2:Identify minerals, rocks, and geological structures relevant to construction.	Understand	PO1 (3), PO7 (2)	Ensures correct material selection and design safety.	Field trips, demonstrations	Field reports, tests
CLO3:Apply geological and geophysical techniques for site investigations.	Apply	PO5 (3), PO7 (2)	Improves accuracy of subsurface assessments.	Practical exercises, mapping	Lab/field reports, practical tests
CLO4:Evaluate geological	Evaluate	PO7 (3), PO11 (2)	Supports safe and	Group projects,	Case study

conditions for major engineering works.			sustainable infrastructure development.	seminars	analysis

CIV3402 – Civil Engineering Drawing (3 Credit Units)

Short Description
Develops skills in graphical communication for civil engineering, including geometrical and architectural drawing, building and structural detailing, road design presentation, mechanical components, and water/environmental engineering structures.
Key Topics

- Geometrical drawing: projection, true lengths, conic sections
- Architectural drawing: dimensional awareness, orthographic, perspective
- Building drawings: plans, elevations, sections, details
- Structural drawings: steel connections, reinforcement detailing
- Road design layouts and profiles
- Mechanical bearings representation
- Water/environmental structures: dams, tanks, sewers

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Produce accurate 2D and 3D civil engineering drawings.	Create	PO5 (3), PO10 (2)	Essential for conveying technical designs effectively.	Studio sessions, CAD practice	Drawing assignments, portfolio
CLO2:Interpret architectural, structural, and infrastructure drawings.	Understand	PO5 (3), PO10 (2)	Ensures correct implementation of designs.	Lectures, demonstrations	Quizzes, oral tests
CLO3:Detail reinforcement, steel connections, and construction layouts.	Apply	PO5 (3), PO2 (2)	Critical for structural integrity and buildability.	Workshops, hands-on practice	Drawing projects, reviews

CLO4:Present road, water, and environmental engineering designs graphically.	Create	PO5 (3), PO7 (2)	Enhances communication of sustainable engineering solutions.	Design studios, case studies	Project submissions, critiques

CIV3403 – Engineering Surveying I (3 Credit Units)

Short Description
Introduces surveying principles, instruments, error theory, and field methods including chain, compass, plane table, levelling, traversing, and tacheometry for engineering applications.

Key Topics
- Surveying instruments: types, adjustments, uses
- Theory of errors: detection and elimination
- Chain surveying
- Compass surveying
- Plane table surveying
- Levelling methods: geometric, trigonometric, tacheometric, altimetric
- Theodolite traversing

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Operate and adjust common surveying instruments.	Apply	PO5 (3), PO1 (2)	Accurate field measurements underpin quality engineering works.	Field demonstrations, practice	Field tests, observation checklists
CLO2:Apply error theory to minimise measurement inaccuracies.	Apply	PO1 (3), PO5 (2)	Improves reliability of survey data for design.	Lectures, exercises	Problem sets, tests
CLO3:Conduct basic chain,	Apply	PO5 (3), PO7 (2)	Supports planning and setting	Field exercises,	Field reports,

compass, and plane table surveys.			out of works.	group work	practical tests
CLO4:Perform levelling and traversing for engineering projects.	Apply	PO5 (3), PO1 (2)	Provides essential data for earthworks and layout.	Practical work, tutorials	Field records, reports

EGR3203 – Students Industrial Work Experience Scheme I (SIWES I) (6 Credit Units)

Short Description
Provides supervised industrial training for students to gain practical experience in engineering practice, bridging classroom learning with real-world applications. Enhances technical, professional, and ethical skills in a workplace setting.

Key Topics/Activities

- Orientation and placement in relevant industry or engineering organisation
- Observation of engineering operations, processes, and equipment
- Participation in supervised technical tasks
- Exposure to safety standards, quality assurance, and project documentation
- Development of workplace communication and teamwork skills
- Preparation of logbook and technical report on activities undertaken

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Apply classroom-acquired engineering knowledge to real-world situations.	Apply	PO1 (3), PO2 (3)	Ensures students can transfer theoretical learning to practical tasks.	Industrial attachment, on-site supervision	Logbook review, supervisor assessment
CLO2:Operate tools, equipment,	Apply	PO5 (3), PO6 (2)	Promotes safe and	Practical work,	Field performance

and processes under supervision following safety protocols.			competent technical skills.	demonstrations	evaluation
CLO3:Demonstrate effective teamwork and communication in a professional setting.	Apply	PO9 (2), PO10 (3)	Prepares students for collaborative and multidisciplinary work.	Group tasks, meetings	Supervisor feedback, peer evaluation
CLO4:Prepare a detailed technical report on industrial experience.	Create	PO10 (3), PO12 (2)	Develops technical writing and lifelong learning skills.	Report writing, mentoring	Report grading, oral defence

LEVEL 400

EGR4301 – Engineering Statistics (3 Credit Units)

Short Description
Introduces statistical methods for engineering applications, covering data presentation, probability theory, probability distributions, correlation, regression, hypothesis testing, and quality control.

Key Topics

- Sampling methods and data presentation (frequency tables, graphs)
- Measures of central tendency and spread
- Probability concepts: conditional probability, independence
- Random variables and probability distributions (discrete, continuous, multinomial, bivariate normal)
- Expectation, variance, law of large numbers, central limit theorem
- Correlation and regression analysis
- Sampling distributions and hypothesis testing
- Quality control applications in engineering

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Apply statistical methods to summarise and interpret engineering data.	Apply	PO1 (3), PO2 (3)	Enables evidence-based engineering decisions.	Lectures, problem-solving	Assignments, quizzes
CLO2:Use probability theory to model engineering uncertainties.	Apply	PO1 (3), PO2 (2)	Supports risk assessment and reliability studies.	Tutorials, examples	Tests, problem sets
CLO3:Perform correlation,	Apply	PO1 (3), PO2 (3)	Helps establish and	Case studies,	Exams,

regression, and hypothesis testing for engineering analysis.			validate engineering relationships.	demonstrations	assignments
CLO4:Implement statistical quality control techniques.	Apply	PO1 (3), PO7 (2), PO11 (2)	Enhances quality assurance in engineering processes.	Practical exercises, labs	Lab reports, project work

CIV4201 – Highway Engineering (3 Credit Units)

Short Description
Covers highway location, design, economics, pavement types, pavement design, maintenance, and construction materials.

Key Topics

- Highway classification and location
- Expressway design and interchanges
- Highway economics
- Geometric design: speed, sight distance, alignments, cross-section elements
- Pavement types: flexible and rigid
- Pavement structural design methods
- Pavement maintenance and materials

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Classify highways and design appropriate layouts.	Understand	PO1 (3), PO2 (3)	Supports efficient and safe transportation planning.	Lectures, field visits	Quizzes, assignments
CLO2:Apply geometric design standards to horizontal and vertical alignments.	Apply	PO1 (3), PO2 (3), PO7 (2)	Ensures compliance with safety and performance criteria.	Tutorials, CAD practice	Design projects, tests
CLO3:Design flexible and rigid pavements using standard methods.	Create	PO2 (3), PO3 (2), PO5 (2)	Provides durable and cost-effective pavement solutions.	Problem-solving, case studies	Exams, project submissions
CLO4:Evaluate highway construction materials for suitability.	Evaluate	PO1 (3), PO7 (2)	Ensures material quality and performance in service.	Laboratory tests, demonstrations	Lab reports, practical exams

CIV4202 – Structural Analysis II (3 Credit Units)

Short Description
Focuses on the analysis of indeterminate structures using classical and matrix methods, including deflection analysis, fixed beams, slope-deflection equations, and influence lines.

Key Topics

- Determinate vs indeterminate structures
- Tests for indeterminacy
- Three-moment equation, method of cross, slope-deflection equations
- Mohr's theorems and moment-area method
- Temperature effects on structures

- Williot-Mohr diagrams for trusses
- Influence lines for beams and frames

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Determine the degree of indeterminacy of structures.	Apply	PO1 (3), PO2 (3)	Fundamental for selecting the right analysis approach.	Lectures, examples	Quizzes, assignments
CLO2:Analyse indeterminate beams and frames using classical methods.	Analyse	PO1 (3), PO2 (3)	Ensures accurate load distribution predictions.	Tutorials, problem-solving	Problem sets, exams
CLO3:Apply influence line theory to assess structural response.	Apply	PO1 (3), PO2 (2)	Supports live load and moving load design.	Case studies, worked examples	Exams, projects
CLO4:Evaluate the effects of temperature and settlement on structural behaviour.	Evaluate	PO1 (3), PO7 (2)	Improves safety and serviceability assessments.	Demonstrations, calculations	Assignments, tests

CIV4203 – Soil Mechanics II (3 Credit Units)

Short Description
Covers advanced topics in soil mechanics including consolidation, settlement analysis, compaction, lateral earth pressure, and retaining wall design.

Key Topics

- Consolidation theory and testing
- Settlement analysis: immediate and consolidation settlement
- Stress path method

- Soil compaction principles and applications in highways
- Lateral earth pressure theories: Rankine and Coulomb
- Retaining wall stability and design

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Analyse consolidation behaviour of soils.	Analyse	PO1 (3), PO2 (3)	Essential for predicting settlement over time.	Lectures, tutorials	Problem sets, quizzes
CLO2:Perform settlement analysis for shallow foundations.	Apply	PO1 (3), PO2 (3)	Ensures serviceability and durability of structures.	Worked examples, software use	Assignments, exams
CLO3:Design compaction requirements for highways.	Apply	PO2 (3), PO5 (2)	Improves pavement performance and longevity.	Lab sessions, case studies	Lab reports, practical tests
CLO4:Evaluate earth pressure and design retaining walls.	Evaluate/Create	PO2 (3), PO3 (2), PO7 (2)	Prevents structural failure and enhances stability.	Problem-solving, design projects	Design reports, exams

CIV4204 – Design of Structural Elements II (3 Credit Units)

Short Description
Introduces steel design principles, covering tension and compression members, beams, connections, composite construction, and continuous beams.

Key Topics

- Properties of structural steel
- Design of tension members and beams
- Shear and deflection in steel beams

- Design of compression members and bases
- Bolted and welded connections
- Composite construction
- Continuous beam design
- Design projects

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Design steel tension and compression members.	Create	PO2 (3), PO3 (2), PO5 (2)	Ensures safe and efficient structural performance.	Lectures, design studios	Design projects, exams
CLO2:Analyse and design steel beams for bending, shear, and deflection.	Analyse/Create	PO2 (3), PO3 (2)	Provides serviceable and economical structures.	Tutorials, problem-solving	Assignments, tests
CLO3:Detail welded and bolted steel connections.	Apply	PO5 (3), PO2 (2)	Ensures constructability and safety in fabrication.	Workshops, CAD practice	Drawing submissions, practical evaluations
CLO4:Apply composite construction principles to beam design.	Apply	PO2 (3), PO7 (2)	Enhances load-carrying capacity and economy.	Case studies, design exercises	Reports, exams

CIV4304 – Civil Engineering Practice (3 Credit Units)

Short Description
Explores civil engineering contracts, methods of measurement, estimation, valuation, and the application of construction machinery in various civil engineering projects.

Key Topics

- Types and scope of civil engineering works
- Nature, form, and enforcement of contracts
- Remedies for breach of contract
- Contract documents and clauses in standard conditions of contract
- Civil Engineering Standard Method of Measurement (CESMM)
- Bills of quantities, specification writing
- Estimating, costing, valuation, and financial control
- Variations and disputes
- Construction machinery and equipment for dams, bridges, highways, industrial buildings, pipelines, sewage works, etc.

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Interpret and apply standard contract clauses in civil engineering works.	Apply	PO6 (3), PO7 (3)	Promotes legal and ethical compliance in engineering projects.	Lectures, case studies	Written tests, assignments
CLO2:Prepare and interpret bills of quantities and specifications.	Apply/Create	PO1 (3), PO5 (2), PO11 (2)	Ensures accurate cost and quality control documentation.	Tutorials, practical exercises	Project work, class exercises
CLO3:Estimate and value civil engineering works for interim and final payments.	Apply	PO5 (3), PO11 (2)	Supports effective financial management in construction.	Worked examples, industry visits	Assignments, valuation reports
CLO4:Select appropriate construction equipment for specific project types.	Evaluate	PO2 (3), PO5 (2)	Improves project efficiency, safety, and productivity.	Case studies, demonstrations	Reports, presentations

CIV4302 – Hydraulics/Hydrology (3 Credit Units)

Short Description
Covers meteorology, hydrology, hydrograph analysis, flow in pipes, compressible flow, and hydraulic modelling for the design of hydraulic structures and systems.

Key Topics

- Meteorological measurements (solar radiation, wind, rainfall, temperature, humidity, etc.)
- Hydrological cycle and water balance
- Runoff estimation and unit hydrograph concepts
- Rainfall–runoff relationships
- Pipe network analysis (Hardy Cross, equivalent pipe, charts)
- Hydraulic design of pipelines and distribution systems
- Compressible flow and flow through hydraulic structures
- Hydraulic model laws and simulation studies

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Measure and analyse meteorological and hydrological parameters.	Apply	PO1 (3), PO2 (3), PO5 (2)	Enables accurate water resource assessment and design.	Lectures, lab work	Lab reports, quizzes
CLO2:Perform hydrograph and rainfall–runoff analysis for catchments.	Analyse	PO1 (3), PO2 (3)	Supports flood prediction and water management.	Problem-solving, case studies	Assignments, tests
CLO3:Design pipeline and distribution systems using	Create	PO2 (3), PO3 (2), PO5 (2)	Ensures efficient water conveyance and	Tutorials, CAD use	Design projects, exams

hydraulic principles.			distribution.		
CLO4:Apply hydraulic model laws to the design of hydraulic structures.	Apply/Evaluate	PO2 (3), PO7 (2)	Enhances safe and cost-effective hydraulic infrastructure.	Simulations, field visits	Reports, project presentations

CIV4303 – Engineering Surveying II (3 Credit Units)

Short Description
Covers advanced geometric design for road alignments, curve setting-out, photogrammetry, triangulation, and hydrographic surveying.

Key Topics

- Horizontal and vertical alignments (simple, compound, reverse, transition curves)
- Summit and sag curves
- Setting-out methods and data computation
- Photogrammetry and triangulation (minor, bridge)
- Hydrographic surveying and shoreline mapping

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Design and set out road curves to specified standards.	Apply	PO1 (3), PO2 (3)	Ensures safe and efficient road geometry.	Lectures, field practicals	Field books, practical tests
CLO2:Apply photogrammetry and triangulation techniques in surveying.	Apply	PO1 (3), PO2 (2), PO5 (2)	Improves accuracy and efficiency in mapping.	Demonstrations, exercises	Reports, assignments
CLO3:Conduct hydrographic surveys and determine shoreline	Apply	PO1 (3), PO2 (3)	Supports marine and coastal engineering	Fieldwork, equipment handling	Field reports, tests

positions.			projects.		

EGR4401 – SIWES II (6 Credit Units)

Short Description
Advanced industrial attachment enabling students to participate in more complex engineering projects, building on SIWES I experience.

Key Topics/Activities

- Placement in relevant industry
- Participation in engineering design and implementation tasks
- Exposure to project management, quality control, and safety systems
- Preparation of detailed logbook and final report

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Integrate advanced engineering knowledge in workplace projects.	Apply/Create	PO1 (3), PO2 (3)	Bridges theory with professional practice.	Industrial attachment	Supervisor evaluation, logbook review
CLO2:Operate within project management and safety systems.	Apply	PO5 (3), PO6 (2)	Enhances safety, efficiency, and compliance.	On-site mentoring	Performance review, field reports
CLO3:Collaborate effectively in multidisciplinary teams.	Apply	PO9 (3), PO10 (2)	Improves teamwork and communication.	Group tasks, meetings	Peer and supervisor feedback
CLO4:Prepare and present comprehensive industrial training report.	Create	PO10 (3), PO12 (2)	Builds technical writing and lifelong learning skills.	Report writing	Report grading, oral defence

EEP4201 – Entrepreneurship Venture Creation and Growth (2 Credit Units)

Short Description
Equips students with skills for starting, managing, and growing engineering-related enterprises.

Key Topics

- Entrepreneurship concepts and opportunities in engineering
- Business planning and feasibility analysis
- Financing and marketing strategies
- Managing growth and innovation
- Risk management and sustainability in ventures

CLO–PO Mapping Table

CLO	Bloom's Level	Mapped POs (Contribution Level)	PO Justification	Teaching Methods	Assessment Tools
CLO1:Identify viable engineering business opportunities.	Understand	PO6 (3), PO7 (3)	Encourages entrepreneurial thinking and societal impact.	Lectures, case studies	Business idea proposals
CLO2:Develop a feasible business plan for a technical venture.	Create	PO3 (2), PO11 (3)	Supports commercialisation of engineering solutions.	Workshops, group work	Business plan submission
CLO3:Apply marketing and financial strategies for business growth.	Apply	PO5 (3), PO11 (2)	Ensures sustainable and profitable operations.	Tutorials, simulations	Assignments, presentations
CLO4:Assess risks and plan for sustainability in engineering ventures.	Evaluate	PO7 (3), PO12 (2)	Promotes long-term impact and adaptability.	Scenario analysis, discussions	Reports, case study analysis

Level 500

CIV5201 – Construction Management and Economics

Description: Covers management principles, organizational structures, work study, industrial psychology, and computer applications in construction.
Key Topics: Organizational/personnel management, work study & time-motion studies, production processes, industrial psychology, computer applications in project planning.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Apply organizational and personnel management principles to civil engineering projects.	PO1, PO11	Apply	Lectures, Case Studies	Written Exams, Reports	PO1: Requires knowledge application; PO11: Relates to project management.
CLO2: Conduct method study and work measurement to optimise construction work processes.	PO2, PO5	Analyze	Practical Sessions, Simulations	Lab Reports	PO2: Analytical skill in process evaluation; PO5: Use of tools/software.
CLO3: Evaluate the role of industrial psychology in improving productivity.	PO6, PO9	Evaluate	Seminars, Discussions	Oral Presentations	PO6: Societal/people context; PO9: Teamwork.

CIV5202 – Public Health Engineering

Description: Examines water, wastewater, and solid waste systems with emphasis on public health protection and sustainability.
Key Topics: Sanitary engineering, water quality, water supply & treatment, wastewater treatment, solid waste management, air pollution control.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Explain the role of public health engineering in disease prevention.	PO6, PO7	Understand	Lectures	Quizzes, Oral Presentations	PO6: Health & safety; PO7: Sustainability.
CLO2: Design water supply and wastewater treatment systems.	PO3, PO7	Create	Design Projects, Field Visits	Design Reports	PO3: Design solutions; PO7: Environmental considerations.
CLO3: Assess solid waste management and air pollution control strategies.	PO2, PO7	Evaluate	Case Studies	Exams, Reports	PO2: Problem analysis; PO7: Sustainability focus.

CIV5401 – Construction Management and Economics II

Description: Advanced project planning, economic evaluation, tendering, and contract administration.
Key Topics: Resource management, environmental management, contracts, CPM, PERT, economic valuation, tendering.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Apply CPM and PERT techniques to project scheduling. Use computer software for construction project planning	PO5, PO11	Apply	Computer Labs, Practical Exercises	Project Plans	PO5: Tools usage; PO11: Project management.
CLO2: Evaluate project economic viability using financial tools.	PO2, PO11	Evaluate	Lectures, Workshops	Reports	PO2: Problem analysis; PO11: Finance.
CLO3: Prepare and evaluate tender	PO3,	Create	Group Work	Tender	PO3: Design of

documents.	PO11			Documents	documentation; PO11: Finance and contracts.
CLO4: Manage post-contract administration processes.	PO8, PO11	Apply	Simulations	Assignments	PO8: Ethics; PO11: Management.

CIV5402 – Geotechnical Engineering

Description: Study of foundation systems, slope stability, site investigation, and soil improvement techniques.
Key Topics: Bearing capacity, shallow/deep foundations, slope stability, site investigation, tropical soils, ground improvement.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Determine bearing capacity and stability of foundations.	PO1, PO2	Apply	Lectures, Problem Solving	Exams, Assignments	PO1: Engineering fundamentals; PO2: Analysis.
CLO2: Analyze slope stability under various conditions.	PO2, PO7	Analyze	Case Studies	Reports	PO2: Problem analysis; PO7: Environmental considerations.
CLO3: Recommend site investigation and soil improvement methods.	PO3, PO7	Create	Field Visits	Design Reports	PO3: Design solutions; PO7: Sustainability.

CIV5403 – Water Resources Engineering

Description: Covers hydrological forecasting, hydraulic structures design, and water resources management.
Key Topics: Hydrological statistics, reservoir design, urban drainage, earth/rockfill/concrete dams, sedimentation control, EIA.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Apply statistical methods in hydrological analysis.	PO1, PO2	Apply	Lectures, Exercises	Exams	PO1: Math application; PO2: Analysis.
CLO2: Design hydraulic structures for water storage and control.	PO3, PO7	Create	Design Studios	Project Reports	PO3: Engineering design; PO7: Sustainability.
CLO3: Assess environmental impacts of water resources projects.	PO6, PO7	Evaluate	Seminars	EIA Reports	PO6: Societal context; PO7: Environmental protection.

CIV5404 – Transportation and Highway Engineering

Description: Design and operation of highways, traffic systems, and pavement structures.
Key Topics: Vehicle & driver characteristics, road geometry, Traffic analysis & control, segments & intersection capacity, pavement design & maintenance.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Apply knowledge of vehicle and driver characteristics for incorporation in planning and design of highway facilities	PO1, PO3	Apply	Lectures, Exercise	Exam	PO1: Science application; PO3: Application in design
CLO2: Analyse traffic stream characteristics for performance assessment of road segments	PO2, PO4, PO9	Analyse	Lectures, Fieldwork	Test, Report, Exam	PO2: Analysis; PO4: Field investigation; PO9: Teamwork

CLO3: Design a traffic signal system for traffic control at intersections	PO3, PO9	Create	Lectures, Fieldwork, Design project	Test, Design Report, Exam	PO3: Design; PO9: Teamwork
CLO4: Design pavement structure for varying traffic load using appropriate materials and supervise construction processes	PO3, PO7	Create	Lectures, Problem Solving	Quiz, Exam	PO3: Design; PO7: Sustainability

CIV5405 – Design of Structural Elements II

Description: Advanced reinforced concrete design for various structural components.
Key Topics: RC beams, slabs, stairs, columns, walls, foundations, retaining walls.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Design reinforced concrete beams and slabs for strength and serviceability.	PO3	Create	Design Studios	Design Reports	PO3: Design competency.
CLO2: Analyze and design columns and walls.	PO1, PO3	Apply	Problem Solving	Exams	PO1: Fundamental knowledge; PO3: Design.
CLO3: Develop foundation and retaining wall designs.	PO3, PO7	Create	Design Projects	Project Reports	PO3: Design; PO7: Environmental safety.

CIV5406 – Structural Analysis III

Description: Advanced methods of analysis for indeterminate structures, including energy methods, plastic theory, and structural dynamics.
Key Topics: Energy and virtual work method, flexibility method, stiffness method, influence lines, yield line analysis, strip method for slabs, plastic theory, introduction to dynamics.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Apply energy and virtual work methods in analyzing indeterminate structures.	PO1, PO2	Apply	Lectures, Problem-solving sessions	Exams, Assignments	PO1: Solid mechanics knowledge; PO2: Analytical skills.
CLO2: Use matrix stiffness method for frame and truss analysis.	PO2, PO5	Apply	Computer Labs, Simulations	Practical Tests	PO2: Analytical reasoning; PO5: Engineering tools usage.
CLO3: Evaluate collapse loads using yield line theory.	PO2, PO3	Evaluate	Case Studies, Design Exercises	Reports	PO2: Analysis; PO3: Design solutions.

CIV5301 – Advanced Public Health Engineering

Description: Advanced design of water and wastewater systems, tertiary treatment, and solid waste management.
Key Topics: Wastewater and water composition, advanced treatment processes, tertiary treatment, effluent reuse, pollution control, solid waste management.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Analyze advanced water and wastewater treatment processes.	PO1, PO2	Analyze	Lectures, Field Visits	Exams, Reports	PO1: Water quality knowledge; PO2: Analysis of treatment systems.
CLO2: Design tertiary treatment systems for pollutant removal.	PO3, PO7	Create	Design Studios	Design Reports	PO3: Design; PO7: Environmental sustainability.
CLO3: Propose solid waste management solutions for urban	PO6, PO7	Create	Case Studies	Presentations	PO6: Societal context; PO7: Sustainability.

communities.					

CIV5302 – Drainage and Irrigation Engineering

Description: Principles and design of irrigation and drainage systems for agricultural and urban uses.
Key Topics: Soil–plant–water relations, irrigation methods, drainage design, hydraulic structures for irrigation, crop water requirements.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Analyze soil–water relationships for irrigation design.	PO1, PO2	Analyze	Lectures, Fieldwork	Exams	PO1: Soil and water science; PO2: Analytical application.
CLO2: Design surface and subsurface drainage systems.	PO3, PO7	Create	Design Projects	Reports	PO3: Design competency; PO7: Environmental sustainability.
CLO3: Evaluate irrigation scheduling for different crops.	PO2, PO7	Evaluate	Case Studies	Assignments	PO2: Analysis; PO7: Sustainability.

CIV5303 – Rock Mechanics

Description: Engineering properties of rocks, rock mass classification, and foundations on rock.
Key Topics: Rock as construction and foundation material, engineering properties of rocks, Rock types, rock mass behavior, foundation on rocks, exploration and testing methods.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Classify rocks and describe their mineral composition, planes of discontinuity, and weathering	PO1	C3 (Apply)	Lectures, Lab Tests	Exams, Lab Reports	PO1: Geological knowledge; PO2: Analysis skills.

characteristics					
CLO2: Evaluate the engineering properties of rocks and rock masses using field and lab methods	PO2, PO4	C5 (Evaluate)	Design Exercises	Quiz	PO3: Design application; PO7: Environmental stability.
CLO3: Apply rock mass classification systems to assess suitability for construction projects	PO2, PO3	C4 (Analyze)	Seminars	Reports	PO7: Sustainability.
CLO4: Design foundations and other civil structures on rock considering bearing capacity and stability	PO3, PO5	C6 (Create)		Design Reports	PO3: Design solutions
CLO5: Recommend rock improvement techniques for various engineering applications	PO4	C5 (Evaluate)		Test	PO6: The Engineer and the World:
CLO6: Select and apply appropriate exploration and geophysical techniques for rock investigations	PO2, PO5	C4 (Analyze)		Exam, Assignment	PO11: Lifelong learning

CIV5304 – Advanced Foundations and Underground Construction

Description: Design and construction techniques for deep foundations, tunneling, shoring, and underpinning.
Key Topics: Site preparation, deep excavations, slope stability, shoring, underpinning, tunneling methods, pile design.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Select appropriate methods for deep excavation and slope support.	PO2, PO3	Apply	Field Demonstrations	Reports	PO2: Problem analysis; PO3: Design decisions.
CLO2: Design deep foundation systems for various loads.	PO3	Create	Design Studios	Design Reports	PO3: Structural design application.
CLO3: Evaluate tunneling methods for different geological	PO2, PO7	Evaluate	Case Studies	Assignments	PO2: Analytical judgment; PO7: Environmental

conditions.					concerns.

CIV5305 – Prestressed Concrete Design

Description: Analysis and design of prestressed concrete members and systems.
Key Topics: Prestressing materials and systems, loss of prestress, bending, shear, bond, compression members, design projects.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Analyze stress distribution in prestressed concrete members.	PO1, PO2	Analyze	Lectures, Problem-solving	Exams	PO1: Structural mechanics; PO2: Analysis.
CLO2: Design prestressed beams, slabs, and compression members.	PO3	Create	Design Workshops	Design Reports	PO3: Structural design skills.
CLO3: Apply partial prestress concepts in structural design.	PO3	Apply	Case Studies	Assignments	PO3: Practical application in design.

CIV5306 – Analysis and Design of Timber Structures

Description: Design of timber members and connections under various loading conditions.
Key Topics: Properties of timber, flexural/compressive members, axial load and bending, connections, Design Project

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1 – Explain the basic properties of timber, including stress grading and defects.	PO1, PO2	Understand	Lectures, Class Discussions	Quizzes, Short Tests	**PO1:** Uses knowledge of materials science. **PO2:** Requires analyzing and identifying defects for structural suitability.
CLO2 – Describe solid, compound, and glulam timber	PO1, PO2	Understand	Lectures, Case Studies	Quiz, Assignment	**PO1:** Involves engineering fundamentals of timber materials. **PO2:** Evaluates structural applications

materials.					for different timber types.
CLO3 – Determine loadings for beams, decks, and columns.	PO1, PO2, PO3	Apply	Problem-Solving Sessions, Tutorials	Assignments, Mid-Semester Test	**PO1:** Requires knowledge of mechanics. **PO2:** Analyzes load paths. **PO3:** Applies results to design solutions.
CLO4 – Analyze timber elements under flexure, tension, compression, and combined loading.	PO1, PO2, PO3	Analyze	Worked Examples, Group Exercises	Class Tests, Problem-Solving Exercises	**PO1:** Applies structural mechanics principles. **PO2:** Involves detailed analysis of loading. **PO3:** Produces design outcomes from analysis.
CLO5 – Apply permissible stress and limit state principles in design.	PO1, PO2, PO3, PO4	Apply / Evaluate	Lectures, Code Review, Design Tutorials	Assignments, Final Exam	**PO1:** Knowledge of codes and material behavior. **PO2:** Safety evaluation under loading. **PO3:** Code-based design. **PO4:** Research/investigation in applying standards.
CLO6 – Design timber connections under varied loading conditions.	PO1, PO2, PO3	Create	Design Classes, Practical Demonstrations	Design Assignment, Final Exam	**PO1:** Understands connectors' behavior. **PO2:** Evaluates connection performance. **PO3:** Creates safe, practical designs.
CLO7 – Collaborate or work individually on real-life timber design projects.	PO3, PO5, PO9, PO11	Apply / Create	Group Projects, Presentations, Field Work	Project Report, Portfolio, Oral Presentation	**PO3:** Produces complete structural designs. **PO5:** Uses modern software/tools. **PO9:** Demonstrates teamwork. **PO11:** Applies project management principles.

CIV5307 – Advanced Construction Technology

Description: Modern concrete technology, advanced construction methods, and use of specialized equipment.
Key Topics: Mix design, precast/prestressed concrete, underwater concreting, extreme weather concreting, construction plants, elevated structures.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification

CLO1: Apply advanced concrete technology in specialized construction scenarios.	PO3, PO5	Apply	Labs, Site Visits	Reports	PO3: Application in design; PO5: Tools/equipment usage.
CLO2: Select and manage appropriate construction equipment.	PO5, PO11	Apply	Demonstrations	Practical Tests	PO5: Tools; PO11: Management.
CLO3: Evaluate construction methods in extreme conditions.	PO2, PO7	Evaluate	Case Studies	Reports	PO2: Analytical skills; PO7: Sustainability.

CIV5308 – Rural and Urban Transport Planning

Description: Planning and analysis of transportation systems in rural and urban contexts.
Key Topics: Transport surveys, traffic theory, land use planning, environmental considerations.

CLO	Mapped POs	Bloom's Level	Teaching & Learning Methods	Assessment Tools	PO Justification
CLO1: Analyze transport systems and traffic flow in urban/rural areas.	PO2, PO7	Analyze	Lectures, Field Surveys	Reports	PO2: Analytical; PO7: Sustainability.
CLO2: Develop transportation plans integrating land use and environmental factors.	PO3, PO7	Create	Planning Studios	Project Reports	PO3: Design; PO7: Sustainability.
CLO3: Recommend policy measures for transportation development.	PO6, PO11	Create	Seminars	Presentations	PO6: Societal context; PO11: Management.

CIV5309 – Advanced Traffic Engineering

Description: Advanced study of traffic flow, control, safety, and engineering measures.
Key Topics: Traffic theory, highway capacity, signal control, parking, traffic safety.

CLO	Mapped	Bloom's	Teaching &	Assessment	PO Justification

	POs	Level	Learning Methods	Tools	
CLO1: Evaluate traffic flow and capacity for urban and rural roads.	PO2	Evaluate	Lectures, Simulations	Exams	PO2: Analytical application.
CLO2: Design traffic control measures to improve safety and efficiency.	PO3, PO7	Create	Design Projects	Reports	PO3: Design; PO7: Environmental/safety.
CLO3: Recommend engineering solutions for traffic safety.	PO6, PO7	Create	Case Studies	Presentations	PO6: Societal context; PO7: Sustainability.