MICHAEL OKPARA UNIVERSITY OF AGRICULTURE UMUDIKE
COLLEGE OF ENGINEERING AND ENGINEERING TECHNOLOGY
BACHELOR OF ENGINEERING (B. Eng.) PROGRAMMES

Introduction

The College of Engineering and Engineering Technology (CEET) at Michael Okpara University of Agriculture, Umudike (MOUAU) was established to provide outcome based transformational engineering education, responsible research and innovation without borders for sustainable agriculture and industrial development. The college offers undergraduate programmes leading to the award of Bachelor of Engineering (B. Eng.) and postgraduate programmes for the awards of Postgraduate Diploma (PGD) and Higher Degrees: Master of Engineering (M. Eng.) and Doctor of Philosophy (PhD) in Engineering. The academic programmes are specially structured to stimulate development of trainees' ingenuity and originality with the aim of producing highly proficient, broad skilled and change driving engineering graduates that are adequately equipped to address the broad spectrum challenges of sustainable industrialization. All our Bachelor of Engineering programmes are offered on full time course-unit system, under the following eight (8) distinct Departments:

1. Department of Agricultural and Biosystem Engineering
2. Department of Chemical Engineering
3. Department of Civil Engineering
4. Department of Computer Engineering
5. Department of Electrical and Electronic Engineering
6. Department of Food Engineering
7. Department of Mechanical Engineering
8. Department of Mechatronics Engineering

The curricula of CEET undergraduate degree programmes were developed based on the provisions of Core Curriculum and Minimum Academic Standards (CCMAS) of National Universities Commission (NUC), Benchmark Minimum Academic and Professional Standard (BMAPS) of Council for the Regulation of Engineering in Nigeria (COREN) and other best practices in line with the vision and mission of Michael Okpara University of Agriculture Umudike as follows:

DEPARTMENT OF AGRICULTURAL AND BIOSYSTEM ENGINEERING
Bachelor of Engineering (B.Eng.) in Agricultural and Biosystem Engineering

1. OVERVIEW OF DEPARTMENT OF AGRICULTURAL AND BIOSYSTEM ENGINEERING

Agricultural and Biosystem Engineering at Michael Okpara University of Agriculture Umudike (MOUAU) operates unique academic programmes which are carefully planned to meet the manpower requirements for agricultural revolution in the country. The program integrate fundamental research in Agricultural machines and implements, soil and water resources conservation, efficient structures for farm animals and farm products, processing of biological materials, rural electrification and alternative energy sources for innovative applications in agricultural production, and value addition to biological systems. Our programs emphasize solving complex problems in agriculture and allied industries through engineering principles and sustainable practices, leveraging the application of AI, automation, machine learning, block chain technology etc, as digital tools to solve Engineering problems in agriculture. Our undergraduate students engage in cutting edge and multidisciplinary research within the nexus of agricultural production, processing and preservation exploring sustainable solutions for food security and rural development. Apart from our direct links to most of the other engineering variables and physical sciences our work in farm machinery, irrigation systems, farm structures and crop processing with robust connections to agronomy, soil and environmental sciences, positions our graduates at the forefront of agro-industrial innovation and revolution. With an experience research and academic team supported with dedicated technologists and craft men our students have build capacity to develop, analyze, simulate and predict the operational ecosystems of agro-machines, implements, equipment, structure and processes. These capacities have prepared them for diverse roles spanning from agricultural value chain, research and industry participation to academia.

2. PHILOSOPHY OF THE PROGRAMME

The philosophy of Agricultural and Biosystem Engineering Department is to produce graduates who can apply engineering principles to solve problems in agriculture and allied industries, enhancing productivity, sustainability, and food security. Through a combination of theoretical and practical knowledge, graduates are equipped with requisite skills to develop innovative solutions that benefit agricultural domains such as crop and food processing, general mechanization of agricultural operations, forestry, and environmental management, etc.

3. OBJECTIVES

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

1. Increase and sustain agricultural (crop and livestock), aquacultural and forest production
2. Maintain a high level of agricultural production without damage or distortion to the environment
3. Minimize the drudgery associated with agricultural production by use of appropriate machinery
4. Improve rural infrastructures by providing desirable amenities for communities
5. Convert bio-based resources to food, fuel and other renewable products

6. Design new generation of devices or processes for agricultural and biological systems
7. Control agricultural and biological systems for natural resource protection, waste remediation and eco-system restoration
8. Develop sensors, control systems and computer models to monitor and control biological processes in industries or the environment
9. Develop innovative green products and industries.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.
- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.
- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.
- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation

5. COURSE OUTLINE

	100 LEVEL - FIRST SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	-
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
FRE 114	Elementary French I	1	E	15	
GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
	100 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 121	Introduction to Agricultural and Biosystem Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory 1	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH 122	Elementary Mathematics II	2	C	30	-
MTH123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	
IGB 121	Readings and Practice in Igbo	1	C	15	-
FRE 124	Elementary French II	1	E	15	
GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

***E - Electives**

	200 LEVEL - FIRST SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering mathematics 1	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
	Total	**20**		**255**	**135**
	200 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 221	Fundamentals of Agricultural Mechanization and Farm Equipment	2	C	30	-
ABE 222	Soil Mechanics for Agricultural Engineers I	1	C	15	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory 11	1	C	-	45
*GET 229	SIWES 1	3	C		135
	Total	**20**		**255**	**135**

* **All SIWES credited in the 2nd Semester of 400-Level**

	300 LEVEL - FIRST SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 311	Design of Machine & Structural Elements	2	C	15	45
ABE 312	Crop Production	2	C	30	-
ABE 313	Soil Science	2	C	30	-
ABE 314	Biosystems Engineering	2	C	30	-
GET 311	Engineering Statistics and Data , Analysis	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	2	C	30	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
GST 312	Peace and Conflict Resolution	2	C	30	-
ENT 312	Venture Creation	2	C	15	45
	Total	**21**		**270**	**135**
	300 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 321	Animal production	2	C	30	-
ABE 322	Land Surveying & Geographic Information system	2	C	15	45
ABE 323	Rural Infrastructural Engineering	2	C	30	-
ABE 324	Farm management, Rural Sociology and Agricultural Extension	2	C	30	-
GET 321	Engineering Economics	3	C	45	
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems & Technology	3	C	30	45
*GET 329	SIWES 1I	4	C		180
	Total	**20**		**270**	**90**

All SIWES credited in the 2nd Semester of 400-Level, *E- elective

	400 LEVEL - FIRST SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 411	Instrumentation & Measurement in Agricultural and Biosystems Engineering	2	C	15	45
ABE 412	Engineering Properties and Material Handling of Bio- Materials	2	C	30	-
ABE 413	Agro-resources Structures and Environmental Control	2	C	30	-
ABE 414	Irrigation and Drainage Principles	2	C	30	
ABE 415	Engineering Hydraulics	2	C	30	
ABE 416	Field Operation and management of Farm Power & Machinery	2	C	15	45
ABE 417	Soil and Water Conservation Engineering	2	C	30	-
ABE 418	Alternative Energy Application to Agriculture	2	C	30	-
ABE 419	Soil Mechanics for Agricultural Engineers II	2	C	30	-
	Total	**18**		**240**	**90**
	400 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 421	Agricultural and Biosystem Engineering Laboratory Practical	1	C	-	45
*GET 229	SIWES 1	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
GET 421	Engineering Project I	2	C	-	90
GET 422	Engineering Valuation and Costing	2	C	30	-
	Total	**16**		**30**	**630**

***All SIWES credited in the 2nd Semester of 400-Level**

	500 LEVEL - FIRST SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
ABE 511	Environmental & Social Impact Analysis	2	C	30	-
ABE 512	Livestock Production Engineering	2	C	30	-
ABE 513	Drone & Robot Technology in Agriculture	2	C	15	45
ABE 514	Mechanization and Integrated Agricultural Production System	2	C	30	-
ABE 515	Crop/Food Processing and Storage of Agricultural Materials	2	C	30	-
ABE 516	Hydrology	2	C	30	
ABE 517	Agro-resources Transportation and Ergonomics	2	E	30	-
ABE 518	Land Clearing and Development	2	E	30	-
**ABE 599	B. Eng. Project	4	C		180
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering law	2	C	30	-
	Total	**17**		**240**	**45**
	500 LEVEL - SECOND SEMESTER				
ABE 521	Aquaculture & Agroponics Engineering	2	C	30	
ABE 522	Design of Agro-resources Machinery	2	C	30	-
ABE 523	Farm and Rural Electrification	2	C	15	-
ABE 524	Green house Technology	2	C	30	-
ABE 525	Tractor & Automotive Management	1	C	15	-
ABE 526	Packaging and Containerization Engineering	1	C	15	-
ABE 527	Foundation Engineering	2	E	30	-
ABE 528	Rural Water Supply and Sanitation	2	E	30	
ABE 529	Agro- Resources Power Machinery System Management	2	E	30	-
**ABE 599	B. Eng. Project	4	C	-	180
GET 521	Engineering Management	3	C	45	-
	Total	**17**		**180**	**180**

****ABE 599 Credited in the 2nd Semester of 500-Level**

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Units C: LH 30)
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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat,

viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

STA 112: Probability I (3 Units C: LH 45)
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

GST 111: Communication in English (2 Units C: LH 15; PH 45)
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)
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 selfreliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

LIB 116: Use of Library (1 Unit C: LH 15)
Introduction and Historical Background of Libraries: Evolution and significance of libraries. The role of libraries in education and research. The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in

self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit *E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France's history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L'agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS:

Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit *E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

ABE 121: Introduction to Agricultural and Biosystems Engineering (2 Units C: LH 30)
Philosophy and evolution of agricultural and biosystems engineering. The role of Agricultural and Biosystems Engineers in the society and human development. The relationship between agricultural and biosystems engineering and the other engineering disciplines. Significance of agricultural and biosystems engineering. Introduction to agricultural and biosystems engineering: farm power and machinery engineering; soil and water engineering; crop processing and storage engineering; farm structures and environment engineering; biosystems engineering. ABE and sustainable development. The global development goals (SDGs). Climate change impacts on agriculture, adaptation and mitigation measures; Climate smart agriculture. Career opportunities in agricultural and biosystems engineering.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)
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.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium, and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional coordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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 in PHY 122 and PHY 124 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.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)

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

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)

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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

ABE 221: Fundamentals of Agricultural Mechanization and Farm Equipment (2 Units: LH 30)
Meaning of agricultural mechanization, aims and objective of agricultural mechanization, levels of agricultural mechanization, challenges and constraints in agricultural mechanization,; basic concepts and categories of agricultural mechanization; benefits of agricultural mechanization; Introduction to Agricultural workshop tools, Introduction to tillage, principle of internal combustion engine, introduction to different implements used in tillage(Plough, harrow, ridger etc), Principles of electric motors in Agricultural machines, introduction to harvesting and processing and storage equipments , introduction to livestock equipments (automatic feeder, drinkers, Milking and milk handling equipments, meat processing equipments) , introduction to water lifting and irrigation equipment , introduction to surveying equipment used in the farm and the operating principles, selection and maintenance procedure, farm machinery costing and records, Introduction to farm building structures

ABE 222: Soil Mechanics for Agricultural and Biosystems Engineers I (1 Units C: LH 15)
Introduction to soil mechanics. Phase relationship, Permeability, Consolidation, Seepage and analysis. Effective stress principle. Stress distribution in soils. Site investigation Machine soil relationship. Failure forces due to small rake angles. Two and Three dimensional soil failures, Soil compaction and its effects on soil properties, Shear strength of soils (Mohr-Coulomb theory, triaxial test)

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)
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 222: Engineering Materials (3 Units C: LH 45)
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 223: Engineering Mathematics II (3 Units C: LH 45)

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 224: Strength of Materials (3 Units C: LH 45)

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

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 226: Electrical and Electronic Engineering Laboratory (1 Unit C: PH 45)

Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

ABE 311: Design of Machine and Structural Elements (2 Units C: LH 15; PH 45)
Contents Design of machine elements: Theories of failure. Design of shafts, belt and pulley drives, gears, sprockets, bolts and nuts, keys and keyways; selection of bearings. Practical session: Use of computer software in machine design. Design of structural elements: Definitions. Hooke's law. Stress and strain due to loading. Torsion of circular members. Shear force. Bending moment and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations. Mohr cycle. Elastic buckling of columns. Design of beams using empirical methods and computer software. Design of columns using empirical methods and computer software. Group design assignment of machine or structural elements or complete system.

ABE 312: Crop Production (2 Units C: LH 30)
Classification and ecology of crops in Nigeria. Nutrient requirements and mineral nutrition of plants. Manures and fertilizers. Plant growth and development. Growth stages. Tillage and weed control. Other cultural practices. Cropping sequences and rotation. Farming systems. Production practices for specified crops. Conservation agriculture and sustainability in tropical agriculture.

ABE 313: Soil Science (2 Unit C: LH 30)
Origin and formation of soils. Physical properties of soils. Basic concept of soil paedology. Soil colloids; soil reaction; soil mineralogy. Soil organic matter. Soil survey and mapping. Soil

classification. Soil fertility and fertilizers. Particle size distribution analysis/sieve analysis. Properties and management of Nigerian soils.

ABE 314: Biosystems Engineering (2 Units C: LH 30)
Definitions. Modelling and design of fermentation systems. Microbial growth kinetics. Design of bio-reactors. Heat and mass transfer. Bioremediation of wastes. design of anaerobic and aerobic systems. Energy from biological systems. Monitoring and control of biological systems. Application of computer to biological processes.

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hypergeometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 313: Engineering Mathematics III (3 Units C: LH 45)
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke‘s theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann‘s Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy‘s Integral Theorems. Bilinear transformation.

GET 314: Engineering Laboratory II (1 Unit C: PH 45)
Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators, and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised

Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

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

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

ABE 321: Animal Production (2 Units C: LH 30)
Types of livestock (for eggs, milk, meat, wool, etc). Distribution of livestock in Nigeria. Livestock housing. Livestock processing equipment.

ABE 322: Land Surveying and Geographical Information System (2 Units C: LH 30)
Definitions. Measurement of distances. Use of minor instruments. Random errors. Chain surveying. Bearing of lines. Levelling. Topographic surveys. Traversing. Theodolite traversing. Plane table surveying. Triangulation. Land shaping and earthwork. Map reading. Photogrammetry. Aerial photography. Geographical Information System.

ABE 323: Rural Infrastructural Engineering (2 Units C: LH 30)
Concept of integrated rural development (planning and implementation). Overview of the problems of rural infrastructures. Review of agricultural construction survey. Rural road network. Rural road design, construction and maintenance; erosion of earth roads; minor road crossing. Small scale irrigation; rural electricity; rural water supplies; rural sanitation. Practical contents: A levelling survey exercise for road construction. Excursion: Visit to an earth dam site and an irrigation project.

ABE 324: Farm Management, Rural Sociology and Agricultural Extension (2 Units C: LH 30)
Management decision making. Functions of management planning, organisation, staffing, directing and controlling. Financial management. Principles of extension: diffusion, adoption and rejection of innovations. Communication and leadership in agricultural extension.

GET 321-Engineering Economics (3 Units C: LH 45)
The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity, Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost, Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Acccounting Concepts-Double Entry system, Journal, Ledger, Trail balance, Final Accounts Book Keeping system, Depreciation - Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems

in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grantoriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems & Technology (3 Units C: LH 30; PH 45)

Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy. Practical Contents Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; trans-esterification of edible oil into biodiesel; simulation of geothermal energy; GeigerMuller or Scintillation Counters‘ determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:
Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, and wooden furniture making processes.
Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS. A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project. Examples of projects should include the following:
a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in Solid Works; and
d. Technical report writing.

ABE 411: Instrumentation and Measurement in Agricultural and Biosystems Engineering (2 Units C: LH 30; PH 45)
Motion, force, torque and shaft power, pressure and sound flux; humidity measurement; application of primary sensing element; data manipulation, computing and compensating devices; data transmission and recording.

ABE 412: Engineering Properties and Handling of Bio- Materials (2 Units C: LH 30)
Physical, mechanical, rheological and thermal properties of agricultural materials. Newtonian and non-Newtonian fluids. Characterization of bio-fluids and fluid food viscometer. Texture and quality of food materials. Mechanical damage. Handling methods. Design and construction of appropriate material handling equipment for tropical products. Economics of material handling. Cleaning, sorting, separation and grading techniques, principles and machines. Particle size analysis. Heat treatment. Dehydration and drying psychometric.

ABE 413: Agro-Resources Structures & Environmental Control (2 Units C: LH 30)
Environmental and structural requirements of crops and livestock. Planning of farm and livestock houses; storage and stores. Design of structural members. Design of livestock houses: poultry, cow, diary, sheep and goat, pig houses. Water supply and sewage disposal. Specifications and selection of farm building materials. Environmental control for plants and livestock. Use of psychometric charts. Farmstead planning and layout

ABE 414: Irrigation & Drainage Principles (2 Units C: LH 30)
Irrigation**:** water requirements in an irrigation system. Methods of irrigation. Frequency and amount of irrigation. Irrigation water scheduling. Evaluating irrigation systems and practices. Design of furrow, basin, drip and sprinkler irrigation. Design of irrigation structures. Design of irrigation systems: border, sprinkler, drip, etc. Design of open channels. Water flow measurement: weirs and flumes. Pumping power requirements. Salinity and quality of irrigation water. Reclamation of saline and alkaline soils. Seepage from canals and canal lining. Design of an

irrigation project. Evaluating irrigation systems and practices. Irrigation water management. Lysimeters.
Drainage: Effect of poor drainage on plants and soils. Drainage requirements of crops, surface drainage. Sub-surface drainage. Design of drainage systems. Envelope materials and their design. Loads on conduits. Drainage pumping. Construction and installation of drains. Maintenance of drains.

ABE 415: Engineering Hydraulics (2 Units C: LH 30: PH:30)
Fluid properties, fluid statics. Fluid motion, continuity, Bernoulli, energy momentum equations. Reynolds number Laminar and turbulent flow pipe flow. Open channel flow. Weirs, flumes, pumps, turbines, outlets, gates, valves. Pipe flow: pipes in parallel and in series. Branched pipes. Simple pipe network. Water hammer. Hydraulic pump. Back water curves. Hardly cross-method of water distribution. Open channel flow. Channel transition and control. Dimensional analysis and similitude reservoir hydraulic and planning. High pressure outlet, gates, valves. Fluid properties. Fluid statics. Fluid motion. Continuity, Bernoulli, energy, momentum equations. Reynolds number. Laminar and turbulent flows. Pipe flow open channel, flow weirs flumes, pumps, turbine, High pressure outlets, gates valve.

ABE 416: Field Operation and Management of Farm Power & Machinery (2 Units C: LH 15: PH 45)
Farm power sources: engine power, wind energy, solar energy, biofuels, manual power, animal draft power. Engine power: the spark ignition and compression ignition engines. Components of the internal combustion engine. The Otto cycle and diesel cycle PV diagrams. Engine operating characteristics – indicated and brake powers, mechanical, thermal and volumetric efficiencies. Measurement of engine power by the Morse dynamometer test. Fuels. The 4-wheel and 2-wheel drive tractors. Farm machinery: tillage, weeders, planters, sprayers, harvesters. Post-harvest machines: grinders, decorticators, shellers, threshers, fruit extractors. Tillage: Primary, secondary and conservation tillage. Types of tillage implements: ploughs, harrows, land planes Force measurement on tillage tools. Conservation agriculture and sustainability in tropical agriculture. Livestock production equipment. Adjustment, maintenance and repair of farm tractors and equipment. Field performance of crop production equipment.

ABE 417: Soil and Water Conservation Engineering (2 Units C: LH 30)
Types of erosion: gully; rill; sheet. Soil erosion by water. Universal soil loss equation. Control of soil erosion by water: agronomic and engineering methods. Agronomic methods: contour farming; wickerwork fences; proper land clearing and development. Engineering methods: stone-pitch works; gabion baskets; hydraulic drop structures – stilling basin; spill way structures. Wind erosion and its control. Desertification and control measures. Design of earth dams and farm ponds.

ABE 418: Alternative Energy Application in Agriculture (2 Units, C: 30)
Fundamentals of Solar Radiation, (Solar irradiance and radiation patterns, Solar energy availability and potential), Solar Heating and Cooling (Solar thermal systems for heating and cooling; Applications in agricultural buildings and greenhouses),Heat Transfer (Principles of heat transfer :conduction, convection, radiation; Heat transfer in solar collectors and storage systems), Solar Energy Conversion Efficiency (Efficiency of solar collectors and systems, Factors affecting efficiency ; temperature, irradiance, etc.), Principles of Solar Collectors (Types of solar collectors ; flat plate, evacuated tube, etc.; Design and operation of solar collectors), Solar Heat Storage and Storage Systems (Sensible heat storage ; water, rocks, etc.; Latent heat storage : phase change materials; Applications in tropical crops), Solar Pumps (Solar-powered water pumping systems;

Applications in irrigation and water supply), Solar Cookers and Ovens (Design and operation of solar cookers and ovens; Applications in rural areas), Bioenergy (Biomass resources : crop residues, animal waste, etc.), Biomass conversion technologies (anaerobic digestion, gasification, etc.), Biogas production and utilization, Wind Energy (Wind energy potential and assessment; Applications in agriculture (irrigation, power generation)), Case Studies and Project Development (- Real-world examples of alternative energy projects in agriculture Project development and feasibility studies)

ABE 419: Soil Mechanics for Agricultural and Biosystem Engineers II (2 Units C: LH 30)
Soil stability analysis (slope stability, retaining walls), Soil erosion and sediment transport, Soil-water interaction (infiltration, drainage), Laboratory testing of soils (Atterberg limits, compaction test), Field testing of soils (Standard Penetration Test, Cone Penetration Test). The earth. Geological Processes. Engineering properties of rocks stratigraph. Geotectonics. Geomorphology, Mineralogy and Petrology. Geology of Nigeria.

ABE 421: Agricultural and Biosystem Engineering Laboratory Practical (1 units C: PH 45)
A complete hands-on introductory practical course on various aspects of agricultural and biosystems engineering. Student will be able to determine the moisture content of various agricultural products (e.g., soil, grains, fruits, or vegetables) using the oven drying method by deploying the use of Oven, weighing balance and desiccators. Determine the particle size diameter of grain. Carry out the sieve analysis of grains. Introduce students to agricultural processing machines, equipments and operational procedures. Introduce students to farm tractors and tillage implements, their components, and basic operations. Demonstrate the operation of the tractor and tillage implements. Have students observe and participate in the operation of the tractor and implements. Introduce students to the concept of soil erosion and measure the effects of rainfall intensity on soil loss. Measure and collect runoff water and sediment. Calculate soil loss and compare results between treatments. Practical sessions on measurement of solar radiation, wind speed and internal combustion engine power output. Determination of mechanical, volumetric and thermal efficiencies of the internal combustion engine using the engine test bed. Measurement of brake power and indicated power of an engine. Measurement of stream flow velocity using flumes, weirs and flow meters and gully cross-sections using the planimeter. Determination of Finess modulus, particle size diameter of grains. Measurement of erodibility and erosivity of soils. Draft measurement using the dynamometer. Measurement of water infiltration into the soil using the infiltrometer. Measurement of water permeability through the soil using the permeameter. Sieve analysis of grains. The slump test for concrete consistency. The cubic test for concrete. Determination of evapotranspiration of plants using the lysimeter

GET 421 Engineering Project I (2 Units C: PH 90)

GET 422 Engineering Valuation and Costing (2 Units C: LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (12 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

ABE 511: Environmental and Social Impact Analysis (2 Units C: LH 30)
Concept of environmental and social consequences/dimensions of development projects. Methods of impact analysis. Physical, sociological, legal, economic, environmental and public health implications of human activities. Effects of changed environments on man. Examples of impact assessment with particular reference to developing countries. Role of environmental engineering in preventing or reducing environmental stress. Environmental and social management plans (ESMP); Planning and policy, administration and organisation of natural resources development and public health. Land use planning and landscape design. Monitoring and evaluation of projects for ESIA compliance. Practical content: Students are expected to undertake an environmental and social impact analysis of an ongoing project on campus.

ABE 512: Livestock Production Engineering (2 Units C: LH 30)
Production systems: rearing, fattening and milk production systems. Rearing systems: objectives; nomadic, transhumant, sedentary, scavenging and industrial (ranching) – organisation, personnel and infrastructures. Design, construction and equipment for housing for pigs, sheep, goats, domestic fowls, cattle and dairy cattle. Fattening production systems: Grass and intensive fattening. Milk production systems: factors limiting tropical milk production; milking bail; milking parlour: selection, design and types. Environmental requirements for animals. Environmental impact on animal growth and reproduction on their general physiology. Assessment of thermal comfort. Parameters affecting thermal comfort of animals. ASHRAE comfort charts. Ventilation systems: natural and automated. Aerodynamics of animal buildings. Building design methodology. Integrating animals with their environment through building designs. Disease control: Causes, factors favouring transmission. Design of buildings to control diseases. Animal waste management: Characteristics of animal wastes. Objectives of waste treatment; aerobic and anaerobic treatment of waste; manure disposal equipment. Excursion: Visit to a functional biogas plant.

ABE 513: Drone and Robot Technology in Agriculture (2 Units C: LH 15; PH: 45)
Automation: Introduction to automation. Control systems: open-loop and closed-loop, feedback control, logic control, on-off control and linear control systems. Control actions: discrete control (on/off); PID controller; sequential control and logical sequence or system state control; computer control. Automation tools: artificial neural network (ANN); distributed control system (DCS); human machine interface (HMI); robotic process automation (RPA); supervisory control and data acquisition (SCADA); programmable logic controller (PLC); instrumentation; motion control;

robotics. Programming languages: introduction to programming language; Matlab programming, R programming, C, C# and C++ programming, Java and Java Script programming and Python programming. Sensors and actuators: introduction to sensors, types and applications. Design and selection of sensors. Introduction to actuators, types and applications. Design and selection of actuators. Drones or Unmanned Aerial Vehicles (UAVs): Introduction, types and classification of drones. Architecture (components) of a drone: flight controller; electronic speed controller (ESC); battery; radio transmitter/receiver; antenna; propellers; electric motor; camera and its accessories.; ground station; intelligent sensors; intelligent battery; GNSS and RTK module. Advantages and disadvantages of drones. Design and selection of drones. Working principles of a drone. Performance considerations criteria of a drone. Application of drones in agriculture. Robots: Introduction, types and characteristics of agricultural robots (Agribot). Primary areas of robotics: operator interface; mobility or locomotion; manipulators and effectors; programming; sensing and perception. Advantages and disadvantages of robots. Robot design process. Design of components of agricultural robots: end effectors; grippers; manipulators. Operating principles of an agricultural robot. Performance evaluation of robots: productive time, overhead time and working efficiency index. Accuracy and repeatability of a robot. Application of robot to agriculture.

ABE 514: Mechanization and Integrated Agricultural Production System (2 Units C: LH 30)
Mechanization**:** Nature and objectives of agricultural mechanization. Factors affecting agricultural mechanization in the tropics. Analysis of production systems. Agricultural mechanization as a strategy for rural development. Impact on food production and on infrastructural development. Linkages with rural industrialization. Case studies of selected farms.
Integrated Commercial Farming:Design and development of Special Integrated Agro-Industrial Production and Processing Zones (SIAPZ); rationale, features and design considerations, farm input, agro-services, production and aggregation centres, agro-industrial hubs and ancillary facilities. Management of production and value-addition hubs, the concept of out-and in-growers for integrating smallholder farmers and women. Management of agri-produce for export.Case studies from Africa and Asia.
Farm Machine Usage: Integrated approach to machine usage and agricultural production sequence. Equipment selection, scheduling of operation, seasonality factor. Machinery factor. Machinery ownership and financing. Gross margin analysis. Optimization of machinery – input combinations. Management of farm enterprise. Case studies.

ABE 515: Crop/ Food Processing and Storage of Agricultural Materials (2 Units C: LH 30)
Cleaning, sorting, grading and separation. Principles, Techniques and machines communition. Particle size analysis. Heat treatment, dehydration and drying. Psychometry, storage types and environment. Deterioration of produce in storage structures. Environmental control in storage. Definition. Heat and mass transfer. Enthalpy and mass balances; sterilization; freezing; fluid flow; pipes; steam, refrigeration; pump and valves. Insulation. Heat exchangers- design and applications. Heat and cold preservation of foods. Food packaging. Food quality control. Principles and design of food equipment, Blanching.

ABE 516: Hydrology (2 Units C: LH 30)
The hydrologic cycle. Solar radiation and weather. Precipitation, Evaporation, Evapotranspiration, infiltration and subsurface flow. Rainfall excess and overland flow. Run-off relations for

agricultural watersheds. Stream flow routing. Groundwater flow (hydraulics). Watershed management. Stream gauging, Hydrographs

ABE 517: Agro-Resources Transportation and Ergonomics (2 Units *E: LH 30)
Farm Roads. Farm transportation system. Need for efficient farm transportation system. Development and construction of farm transportation equipment .Farm transport- systems, standards and specification, Ergonomics; factors that affect the operators, Man machine relationship. Anthropometry, Human energy generation and measurement.

ABE 518: Land Clearing & Development (2 Units E: LH 30)
Land resources and Land Use Act in relation to Nigerian agriculture. Objectives, methods and equipment for land clearing and development. Machinery selection, mechanics of operation and vegetation types. Land reclamation. Earthmoving machinery and earthmoving mechanics

GET 511: Engineering Project Management (3 Units C: LH 45)
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 512: Engineering Law (2 Units C: LH 30)
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication
termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of Engineering and Technology 105 New torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

ABE 521: Aquaculture and Agroponic Engineering (2 Units C: LH 30)
Aquaculture: Types of fish ponds. Design and construction of fish ponds. Integrated fish farming. Water quality for fish farming. Water conservation. Machinery for fish farms. Pollution control. Ecological re-use and disposal of water. Product harvesting, sorting and processing. Design of fish kilns. Agroponics: Agroponic farming systems. Prospects of agroponic agriculture in Nigeria. Soil and water management in agroponic systems. Economics of agroponic systems. Modern aquaponics and hydroponics systems design and use. Practical content: Each student is expected to plant a yam seedling in a bag of sand and monitor its growth until harvest during the semester. Excursion: Visit to a commercial fish farm site or the university fish farm.

ABE 522: Design of Agro-Resources Machinery (2 Units C: LH 30)
Machine design processes and procedures. Materials of construction, selection, strength properties, stress analysis and costing. Design of machine elements. Machine fabrication. Typical design of low cost agricultural machinery. Problems and prospects of agricultural machinery development, and commercial manufacture in Nigeria

ABE 523: Farm and Rural Electrification (2 Units C: LH 30)
Electrical codes, tariffs, and regulation. Generation and transmission of electricity. Farmstead distribution systems. Testing procedure. Power factor correction. Selection and use of electric motors. Transformers. Energy conversion. Application of electricity to handling, processing and storage of agricultural products. Basic electronic applications to farm electrical processes.

ABE 524: Greenhouse Technology (2 Units C: LH 30)
Definition of greenhouse. Meaning of greenhouse technology and controlled environment agriculture (CEA). History and present scenario of greenhouse cultivation. Importance of greenhouse crop cultivation. Types of greenhouses. Types of covering materials and thermal screens for greenhouses. Planning of greenhouses. Importance of different climatic and non-climatic factors in selecting proper greenhouse technology. Measuring systems required for greenhouse. Design, construction and cost estimate of a greenhouse. The bamboo greenhouse technology. Control mechanisms for different climatic conditions: light, temperature, humidity, precipitation and carbon dioxide. Special methods of crop husbandry in greenhouse cultivation. Excursion: Visit to a commercial farm with greenhouse facility.

ABE 525: Tractor & Automotive Management (1 Units C: LH 15)
Identification of the components of an internal combustion engine (spark ignition and compression ignition). The various internal combustion engine systems: lubrication, electrical ignition, cooling, transmission, fuel, steering and brake. Schedule maintenance practices. Hands-on service and maintenance of all the components of a tractor and automobiles.

ABE 526: Packaging & Containerization Engineering (1 Units C: LH 15)
Purpose of packaging food and biomaterials. Packing types. Marketing requirements for packaging. Storage environmental requirements. Types of packing configuration. Palletization. Canning technology. Aseptic processing and packaging. Modified atmosphere packaging and applications. Maximum allowable load concepts and containerization design.

ABE 527: Foundation Engineering (2 Units E: LH 30)
Stress in soils. Consolidation, compaction. CBR and soil improvement. Stability of slopes. Earth pressure analysis. Bearing capacity and settlement analysis of shallow and deep foundations. Design of footings, foundations, retaining walls. Analysis and control of groundwater.

ABE 528: Rural Water Supply & Sanitation (2 Units E: LH 30)
Water requirements. Water quality standards. Water borne disease. Biochemical oxygen demand. Potable water impurities. Sources and treatment methods of water for rural homes. Water lifting devices. Transportation and distribution systems. Pipes sizes. Waste disposal in rural areas. Collection, conveyance, treatment and disposal of sewage from rural homes. Septic tanks, digestion ponds and family privies.

ABE 529: Agro-Resources Power and Machinery Systems Management (2 Units *E: LH 30)
Types of farm machinery. Force analysis and design consideration of various farm machinery. Hitching methods. Power requirements for operating farm equipment and machines. Field evaluation. Criteria for replacement. Integrated approach to machinery usage and agricultural production sequence. Equipment selection, scheduling of operation, seasonal factor. Machinery management. Machinery ownership and financing. Gross margin analysis. Optimization – input combination management of farm enterprise.

ABE 599: Final Year Project (4 Units C: PH 180)
Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must present a project proposal seminar before the beginning of the project. This course lasts for one academic session

GET 521 – Engineering Management (3 Units C: LH 45)
Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

DEPARTMENT OF CHEMICAL ENGINEERING
Bachelor of Engineering (B.Eng.) in Chemical Engineering

1. OVERVIEW OF DEPARTMENT OF CHEMICAL ENGINEERING

The Department of Chemical Engineering at Michael Okpara University of Agriculture, Umudike, is committed to producing highly competent engineers equipped with the theoretical knowledge, practical skills, and innovative mindset required to excel in today's global engineering landscape. The department offers a robust academic program that blends foundational courses in chemistry, physics, biology, and mathematics with advanced engineering subjects such as thermodynamics, transport phenomena, reaction engineering, separation processes, and process design and control. The academic structure is built on a dynamic integration of classroom-based theoretical learning, hands-on laboratory experiments, and intensive workshop training. Students are further exposed to real-life engineering environments through well-coordinated industrial training schemes and research-based projects that encourage critical thinking, innovation, and problem-solving. These experiences prepare students to address complex challenges in energy, sustainability, biotechnology, environmental protection, and material science. To support holistic development, the department actively promotes student participation in extracurricular activities such as engineering innovation clubs, technical competitions, industrial visits, entrepreneurship programs, and professional networking events. These initiatives are aimed at building leadership, communication, teamwork, and professional ethics—ensuring that graduates are not only technically sound but also well-rounded individuals capable of making meaningful contributions on both national and global stages. With a dedicated team of academic and technical staff, modern facilities, and a student-focused learning environment, the Department of Chemical Engineering remains a hub for nurturing future-ready engineers and innovators.

2. PHILOSOPHY

The department aims to produce highly skilled engineers equipped with strong academic and soft skills, capable of designing, optimizing, and innovating chemical processes to drive industrial growth, environmental sustainability, and national development, while applying broad scientific, technological, and analytical expertise to solve complex 21st-century challenges in diverse fields including energy, environment, biotechnology, and materials science.

3. OBJECTIVES

The objectives of the chemical engineering programme are, amongst others, to:

1. Apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to solve Chemical Engineering related problems;
2. Design solutions for Chemical Engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, environmental and other ethical considerations;
3. Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;
4. Create, select and apply appropriate techniques, resources and modern engineering and IT tools: including prediction and modeling, to complex engineering activities, with an understanding of the limitations;

5. Function effectively both as an individual and as a team member or leader in diverse and in multi-disciplinary settings;
6. Communicate effectively on complex engineering activities with the engineering community and with society at large;
7. Apply the knowledge and understanding of engineering and management principles in managing multi-disciplinary projects;
8. Create awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
9. Develop entrepreneurial skills and knowledge, in addition to adequate training in human and organisational with a spirit of self-reliance so that they can set up their own businesses.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes.

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**

For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.

- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**

Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.

- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**

Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.

- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**

A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.

- **Performance Standards for COREN Indexing and Progression**

Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level

and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability I	3	C	45	-
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
IGB 111	Basic Igbo Literacy	1	C	15	-
LIB 116	Use of Library	1	C	15	-
FRE 114	Elementary French I	1	E	15	-
GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
	100 LEVEL - SECOND SEMESTER				
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TCH 121	Introduction to Chemical Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	-
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY 122	General Physics II	2	C	30	-
PHY124	General Physics IV	2	C	30	
PHY 127	General Practical Physics II	1	C	-	45
IGB 121	Readings and Practice in Igbo	1	C	15	-
ENG 121	Use of English	1	C	15	
FRE 124	Elementary French II	1	E	15	-
GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

***E – Elective courses**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Student Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**
200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TCH 221	Chemical Engineering Fundamentals	3	C	45	-
TCH 222	Material Science	3	C	45	-
TCH 223	Statistics for Chemical Engineers	2	C	30	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 223	Engineering Mathematics II	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronic Engineering Laboratory	1	C	15	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C		135
	Total	**19**		**255**	**135**

***All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
TCH 311	Transfer Processes I	2	C	15	45
TCH 312	Separation Processes I	2	C	30	-
TCH 313	Chemical Engineering Laboratory I	1	C	-	45
TCH314	Chemical Kinetics and Catalysis	2	C	30	
TCH315	Biochemical Engineering	2	C	30	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	
GET 313	Engineering Mathematics III	3	C	45	
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	
	Total	**20**		**240**	**180**
300 LEVEL SECOND SEMESTER					
TCH 321	Chemical Engineering Thermodynamics I	2	C	30	-
TCH 322	Process Instrumentation	2	C	30	-
TCH 323	Chemical Engineering Laboratory II	1	C	-	45
TCH 324	Numerical Methods in Chemical Engineering	2	C	30	-
GET 321	Engineering Economics	3	C	45	
GET 322	Technical Writing and Communication	3	C	45	
GET 323	Engineering Mathematics IV	3	C	45	
GET 324	Renewable Energy Systems and Technology	3	C	30	45
GET 329	SIWES II	4	C	-	180
	Total	**19**		**255**	**90**

***All SIWES credited in the 2nd Semester of 400-Level**

400 LEVEL FIRST SEMESTER						
Course Code	**Course Title**	**Preq**	**Units**	**Status**	**LH**	**PH**
TCH 411	Chemical Engineering Thermodynamics II	TCH 322	2	C	45	
TCH 412	Chemical Reaction Engineering I		3	C	45	-
TCH 413	Chemical Product Design		3	C	15	90
TCH 414	Plant Design and Economics		3	C	45	
TCH 415	Process Control		2	C	30	45
TCH 416	Process Modelling and Simulation		2	C	30	-
TCH 417	Transfer Processes II	TCH 311	2	C	30	-
TCH 418	Chemical Engineering Laboratory III		1	C		45
	Total		**18**		**240**	**180**
400 LEVEL SECOND SEMESTER						
GET 421	Engineering Project I		2	C	-	90
GET 422	Engineering Valuation and Costing		2	C	30	
TCH 421	Chemical Process Technology		1	C	-	45
GET 229	SIWES I		3	C	-	135
GET 329	SIWES II		4	C	-	180
GET 429	SIWES III		4	C	-	180
	Total		**16**		**30**	**630**

***All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL FIRST SEMESTER						
Course Code	**Course Title**	**Preq**	**Unit**	**Status**	**LH**	**PH**
GET 511	Engineering Project Management		3	C	45	
GET 512	Engineering Law		2	C	30	
TCH 511	Plant Design II		4	C	30	135
TCH 512	Chemical Reaction Engineering II (Heterogeneous System)	TCH 412	2	C	30	
TCH 513	Chemical Process Optimization	TCH 416	3	C	45	
TCH 514	Separation Processes II (Multi component System)	TCH 313	2	C	30	
TCH 515	Pulp and Paper Technology		2	E	30	
TCH 516	Sugar Technology		2	E	30	
TCH 517	Polymer Science and Engineering		2	E	30	
TCH 518	Membrane Technology		2	E	30	
TCH 519	Process Integration		2	E	30	
**TCH 555	Chemical Engineering Research Project		4	C	-	180
	Total		**18**		**210**	**315**
***Choose at least one elective**						
500 LEVEL SECOND SEMESTER						
GET 521	Engineering Management		3	C	45	
TCH 521	Process Safety and Loss Prevention in Industries		3	C	30	
TCH 522	Environmental Pollution and Control		2	C	30	-
TCH 523	Coal Processing Technology		2	C	30	-
TCH 524	Petroleum Processing and Petrochemicals		2	C	30	
TCH 525	Bio Refinery Engineering		2	E	30	
TCH 526	Fermentation Technology		2	E	30	
TCH 527	Cement Technology		2	E	30	
**TCH 555	Chemical Engineering Research Project		4	C	-	180
	Total		**18**		**165**	**180**

****TCH 555 – Chemical Engineering Research Project should be taken/taught over the two semesters of the final year. The unit is considered in the second semester.**
***Choose at least one elective (E) course per semester of final year**

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)
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.

CHM 113: General Chemistry I (2 Units C: LH 30)
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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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; Bernoulli's equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 117: General Practical Physics I (1 Unit C: PH 45)

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

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

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

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

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, generalization and explanations). Ethical considerations, copyright rules and infringements. Writing activities: pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). Post-writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

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

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

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

LIB 116: Use of Library (1 Unit C: LH 15)

Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research.

FRE 114: Elementary French I (1 Unit E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING

(GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS.

GER 115: Elementary German I (1 Unit E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

TCH 121: Introduction to Chemical Engineering (2 Units C: LH 30)
The role of the chemical engineer. Units and dimensions. The mole unit. Conventions in the method of analysis and measurement. Temperature. Pressure. Physical and chemical properties and measurement. Techniques of solving problems. The chemical equation stoichiometry, material balances in single units, recycle, bypass, purge. This course will be supported with guest lectures from senior chemical engineers in industries, government and academia.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design,

drawing, animation, rendering and simulation work spaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

FRE 124: Elementary French II (1 Unit E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)

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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)

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

human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

TCH 221: Chemical Engineering Fundamentals (3 Units C: LH 45)
Analysis of material balances for multiple systems. Analysis of material balances problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving species and elements for reacting and non-reacting systems. Material balances in process flow sheets. Energy balances procedures; energy balances for reactive and non-reactive processes; combined mass and energy systems. Computer aided balance calculations.

TCH 222: Material Science (3 Units C: LH 45)
Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramics and polymers. Principles of the behaviour of materials in common environments. Phase diagrams and phase transformations of metal solutions. Effect of engineering design, engineering materials processing, selection, manufacturing and assembling on the performance and service life of engineering materials. Corrosion: types, causes and effects of corrosion, corrosion prevention and mitigation. Fabrication processes and applications. Basic nanotechnology, nano-materials and engineering applications.

TCH 223: Statistics for Chemical Engineers (2 Units C: LH 30)
Chemical engineers must have an appreciation of the accuracy and reliability of measurements. This course provides a broad introductory knowledge of statistical techniques used in data analysis. It also seeks to link the measurement of various quantities with statistics to enable the analysis of the accuracy of the measurements. Statistical inference intervals, tests hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Students to have weekly or fortnightly computer laboratory-based assignments.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)
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 223: Engineering Mathematics II (3 Units C: LH 45)
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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

TCH 311: Transfer Processes I (2 Units C: LH 15; PH 45)
Steady State Conduction. Forced and Natural Convection. Reynolds' Analogy. Heat Transfer Film Coefficient Correlations. LMTD Heat Transfer Design. Fouling Factors. Radiation; Blackbody Radiation, Emission from Real Surfaces. Kirchhoff's Law. Unsteady-State Conduction. 2-D Conduction. Fundamentals of Mass Transfer. Similarity of Momentum, Heat and Mass Transfer. Convective Mass Transfer. General, Molecular and Turbulent Diffusion Equations. Fick's Law for

Diffusion. Molecular Diffusion in Gases, Liquids and Solids. Diffusion Coefficients in Gases. Liquids. Shell and Tube Heat Exchangers. LMTD Correction Factors. Heat Transfer and Pressure Drop Correlations. HX Design and Performance (Kern's and NTU Methods for Multipass and Cross-Flow HX). Compact Heat Exchangers. Plate Heat Exchangers. Operating Principles, Series and Parallel Combination, Use and Limitations. Comparison with Shell and Tube Heat Exchangers.

TCH 312: Separation Processes I (2 Units C: LH 15; PH 45)
Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation, flash distillation; distillation systems - types of condensers and reboilers, plate versus packed columns, reflux ratio, Distillation of binary mixture - McCabe Thiele method: rectifying and stripping section, feed plate; Ponchon-Savarit method.

TCH 313: Chemical Engineering Laboratory I (1 Unit C: PH 45)
Laboratory experiments in transport phenomena. Kinetics and separation process

TCH 314: Chemical Kinetics and Catalysis (2 Unit C: PH 30)
Introduction to chemical reactions. Classifications of chemical reactions. Definition of rates of a chemical reaction. Factors affecting the rate of chemical reactions. Identification of rate equations and constants. Arrhenius relationships in chemical reactions. Orders of chemical reactions. Activation energy and chemical reactions. Frequency factors and determinations in chemical reactions. Introduction to catalysis. Determination of the mechanism of reactions. Kinetics of homogenous non-catalytic reactions. Kinetics of heterogeneous non-catalytic reactions. Kinetics of catalytic homogenous reactions. Kinetics of catalytic heterogenous reactions. Deactivation of catalysts. Physicochemical characterization of catalyst deactivation. Construction of mathematical models.

TCH 315: Biochemical Engineering (2 Units C: LH 30)
Introduction to microbiology and biochemistry. Classification and growth characteristics of micro-organisms. Enzymes engineering: including enzyme kinetics, aerobic and anaerobic respirations, metabolic pathways, cell growth kinetics and models

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 313: Engineering Mathematics III (3 Units C: LH 45)
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several

variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

]GET 314: Engineering Laboratory III (1 Unit C: PH 45)

Introduction to IoT, AI and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

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

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace and Human Development. Approaches to Peace and Conflict Management (religious, government, community leaders).

Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive and Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union and Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

TCH 321: Chemical Engineering Thermodynamics I (2 Units C: LH 30)

Heat Effects. Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clasius-Clapeyron equation, standard heats of reaction, formation and combustion effect of temperature on heat reaction. Heat of mixing and solution, Enthalpy concentration diagrams for H_2SO_4, H_2O, etc., partial enthalpies. Chemical Reaction Equilibria; Standard free energy change and equilibrium constant, Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; calculation of conversion; Gas phase reactions, Percentage conversion; Liquid phase reaction Heterogeneous reactions.

TCH 322: Process Instrumentation (2 Units C: LH 30)

Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems. Description and use of current instrumentation such as atomic spectroscopy, infra-Red spectroscopy, High Performance Liquid Chromatography, Scanning Electron Microscope (SEM)

TCH 323: Chemical Engineering Laboratory II (1 Unit; C; PH 45)

Laboratory experiments in Separation processes, Batch sedimentation, fluid circuit system, fluid particle system, saponification in a batch reactor, Vortex tube, Double pipe heat exchanger, Efflux time determination, Screen analysis classification, Distribution coefficient of benzoic acid in Benzene, Terminal velocity, Investigating the effect of changes in hot and cold fluid flow rate on the temperature efficiencies, Overall heat transfer coefficient using shell and tube exchanger, laminar flow demonstration, Drying operation, Process parameters measurement.

TCH 324: Numerical Methods in Chemical Engineering (2 Units C: LH 30)

Numerical methods for solving problems arising in heat and mass transfer, fluid mechanics, chemical reaction engineering, and molecular simulation. Topics: numerical linear algebra, solution of nonlinear algebraic equations and ordinary differential equations, solution of partial differential equations (e.g., Navier-Stokes), numerical methods in molecular simulation (dynamics, geometry optimization). Runge Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation. All methods are presented within the context of chemical engineering problems.

GET 321: Engineering Economics (3 Units C: LH 45)

The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit

Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity. Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost. Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Accounting Concepts-Double Entry System, Journal, Ledger, Trail balance, Final Accounts Book Keeping System, Depreciation-Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)

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

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

]Current and potential future energy systems in Nigeria and globally - resources, extraction, concepts in energy conversion systems; parallels and differences in various conversion systems and end-use technologies, with emphasis on meeting 21st-century national, regional and global energy needs in a sustainable manner. Various energy technologies in each fuel cycle stage for

fossil (oil, gas, synthetic), nuclear (fission and fusion) and renewable (solar, biomass, wind, hydro, and geothermal). Energy types, storage, transmission and conservation. Analysis of energy mixes within an engineering, economic and social context. Sustainable energy; emphasise sustainability in general and in the overall concept of sustainable development and the link this has with sustainable energy as the fundamental benefit of renewable energy.
Practical Contents: Simple measurement of solar radiation, bomb calorimeter determination of calorific value of fuels and biomass; measurement of the velocity of wind, waves and the energy that abound in them; laboratory production of biogas and determination of energy available in it; simple conversion of solar energy to electricity; trans-esterification of edible oil into biodiesel; simulation of geothermal energy; Geiger-Muller or Scintillation Counters' determination of uranium or thorium energy; simple solid or salt storage of energy; hybrid application of renewable energy.

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (Students are to proceed on three months of work experience i.e. 12 weeks during the long vacation following 300 level). Students are engaged in the more advanced workshops, indoor software design training similar to what they will use in the industry and outdoor construction activities to sharpen their skills. The use of relevant animation videos that mimic industrial scenarios is encouraged. Students are to write a report at the end of the training. As much as possible, students should be assisted and encouraged to secure 3 months placement in the industry. Examples of outline of activities and experiences to which students are expected to be exposed to earn prescribed credits include:
Section A**:** Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc. Simple milling machine operations, machine tool maintenance and trouble-shooting, and wooden furniture making processes.
Section B**:** Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.
A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.
Examples of projects should include the following:

a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

TCH 411: Chemical Engineering Thermodynamics II (2 Units; C: LH 45)
Phase Equilibria. Criteria of equilibrium. Fugacity of a pure component. General Fugacity relations for gases. Fugacity of gas mixtures. Effects of temperature and pressure of fugacity. pressure temperature composition relationship. Phase behaviour at low and elevated pressure. Raoult's law Henry's Law. Equilibrium constant. Activity coefficient. Gibbs-Duhem equation. Margueles and

Van Leer equations Chemical Reaction Equilibria. Standard free energy change and equilibrium constant. Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; conversion calculation. Gas phase reactions, Percentage conversion. Liquid phase reaction. Heterogeneous reactions

TCH 412: Chemical Reaction Engineering I (3 Units C: LH 45)
Introduction to chemical kinetics; concentration versus time equations for single, irreversible reactions; concentration versus time equations for reversible reaction; design of the ideal PFR, CSTR; batch and semi-batch reactors and CSTRs in series. Real tubular reactors in laminar flow; Real tubular reactors in turbulent flow; packed bed reactors; unsteady reactors; residence time distribution functions for non-ideal flow reactors.

TCH 413: Chemical Product Design (3 Units C: LH 15; PH 90)
Chemical Engineering open-ended problems/projects that require students to design a chemical process or product. Each team generates and filters ideas; identifies use cases and objectives; evaluates and selects a design strategy; develops a project budget; schedules milestones and tasks; and writes a proposal with supporting documentation. Each project must meet specified requirements for societal impact, budget, duration, person hours, environmental impact, safety, and ethics. Principles of chemical engineering business start-ups.

TCH 414: Plant Design and Economics (3 Units C: LH 45)
Presentation and discussion of real process design problems; sources of design data; process and engineering flow diagram; process outline charts incorporating method study and critical examination; mechanical design of process vessels and piping. Environmental considerations site considerations; process services. Costing of design Process. Formulation of feasibility report evaluation. Economics and safety consideration must be stresses. Computer aided Design; application of software packages in design.

TCH 415: Process Control (2 Units C: LH 30)
Process dynamics. Transfer functions. Frequency response analysis. Discrete events. Control system design. Cascade control. Feed forward and feedback control. Introduction to multi variable control. The control valves.

TCH 416: Process Modelling and Simulation (2 Units C: LH 30)
Use of computational tools to solve models and implicit equations covering transfer, separation, chemical reactions and thermodynamic systems involving steady and unsteady state. Process simulation using the HYSYS software or any other process simulation software, including ASPEN, MATLAB, Geogebra, Winplot, ESES.

TCH 417: Transfer Processes II (2 Units; Core; LH 30)
Basic Laws of mass momentum and energy transfer process and their relationship. Measurement calculations and prediction of transport coefficients. Viscosity and the Mechanisms of Momentum. Transport, shell momentum balances and velocity distributions in laminar flow. Velocity distributions in a turbulent flow. The equations of change for isothermal systems. The equation of continuity. The equation of motion. The equation of mechanical energy. The equation of angular momentum. The equations of change in terms of the substantial derivative. Use of the equations of change to solve flow problems. Shell momentum balances and velocity distributions in laminar

flow. Shell momentum balances and boundary. Flow through a circular tube. Pressure drop for creeping flow in a condition. The flow of a falling film. Simple problems involving dimensionless groups, such as Re Sc Pr. Boundary layer theory and turbulence. Navier Stokes equation. Universal Velocity profile. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Interphase mass transfer.

TCH 418: Chemical Engineering Laboratory III (1 Units; Core; PH 45)
Selected experiments in Heat Transfer. Thermodynamics. Chemical Reaction Engineering. Biochemical Engineering. Process Dynamics and control.

GET 421: Engineering Project I (2 Units C: PH 90)
In the second semester of the 400-level students, preferably in groups, work from the University on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units C: LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices.
Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

TCH 421: Chemical Process Technology (1 Unit; C PH 45)
Practical Production and application of Oils, Fats and Waxes: Extraction and reforming of vegetable oils. Hydrogenation. Trans-esterification. Soaps and Detergents production. Raw materials. Manufacture, properties and uses of glycerine.
Practical Production and application of Essential Oils, Fragrances and Flavours: Practical recovery of volatile oils. Synthetic and semi-synthetic essential oils use. Natural fruit concentrates. Perfume production: Synthesis and uses.
Practical Production and application of Cosmetics: A general study including the preparation of cosmetics and perfumes in terms of raw materials such as emulsifiers (natural, synthetic and finely dispersed solids). Lipid components (oils, waxes, fats). Humectants, colours (dyes and pigments). Preservatives and antioxidants. Cosmetics for skin (Types and problems of skin). Key ingredients of skin cleansing: Toners. Moisturizers, Nourishing. Protective. Talcum powder. Bleaching products. Hair care: Classification. Special additives for conditioning and scalp health. Hair colorants. The plant materials (herbs) used in hair cosmetics.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research

institute or regulatory agencies etc., for a period of 6 months under the guidance of appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

GET 511: Engineering Project Management (3 Units C: LH 45)

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

GET 512: Engineering Law (2 Units C: LH 30)

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

TCH 511: Plant Design II (4 Units C: LH 15; PH 135)

A design problem involving the study of a process. It should consist of preparation of flow sheet and heat and mass balances of the process and a detailed design of plant or unit operation equipment used in the process. Due consideration must be given to economics and safety. Each student is expected to submit and orally defend a bound copy of technological/engineering design project. A design project should consist of introduction, literature review, process design, detailed

design of some of the units of the process, specification of the equipment required, specification of materials of construction, basic mechanical design and drawings, inclusion of process control, modern drawings of the process equipment including a good flow chart, economic and environmental considerations.

TCH 512: Chemical Reaction Engineering II (2 Units, C, LH 30)

Non-catalytic Heterogeneous Reactions: Selection of model. Progressive Conversion model. Unreacted core model. Determination of controlling step. Design application. Catalysis and Catalytic Reactors: Overview of solid catalysed reactions. Rate equations for surface kinetics. Mass transfer between the bulk fluid phase and external catalyst surface in isothermal reactors. Pore and film diffusion resistances. Deactivation and regeneration of catalysts. Porous catalyst particles. Deriving the global reaction rate expression. Determination of rate controlling step. Effectiveness factor for flat-plate. Cylindrical and spherical catalyst pellets. Performance equation for catalytic reactors with porous catalysts. Pressure drops in packed bed catalytic reactors. Heat effects in catalytic reactors. Adiabatic packed bed catalytic reactors.

TCH 513: Chemical Process Optimization (3 Units; C; LH 45)

Nature and organization of optimisation problems: Examples of chemical Engineering applications of optimisation. General procedure for solving optimisation problems. Developing models for optimisation: Classification of models. How to build a model. Selecting functions to fit empirical. Economic objective functions. Time value of money in objective functions and measures of profitability. Basic concepts of optimisation theory: Continuity of functions. Convexity, concavity and their applications. Necessary and sufficient conditions for an extremum of an unconstrained function. Optimisation of unconstrained functions: One-Dimensional Search Methods. Unconstrained multivariable optimization techniques. Linear programming. Quadratic programming. Successive quadratic programming. Using Non-linear programming software: MATLAB optimisation toolbox. Dynamics programming: optimization of the staged system. Applications in heat transfer.

TCH 514: Separation Processes II (2 Units; C; LH 30)

Drying mechanism. Rate of drying and estimation of drying periods. Industrial dryer design. Solvent extraction. Introduction to gas absorption. Evaporation. Evaporation equipment and operation methods. Multiple effect evaporation. Evaporator performance and efficiency. General problems of multicomponent systems. Approximate method for multicomponent multistage operation. Fenske Underwood and Gilliland's method for multistage, multicomponent separation. Kremser Method. Multicomponent gas absorption. Distillation of multicomponent mixtures. Introduction to membrane separation technology. Types of membrane separation processes. Gas permeation and various models for gas separation membrane process. Design of selected multicomponent separation equipment

TCH 515: Pulp and Paper Technology (2 Units; E; LH 30)

Present status of pulp and paper manufacture. Fibrous raw materials. Wood composition. Fibre chemistry. Overview of paper manufacturing. Paper Properties: Physical (optical, strength, and resistance). Chemical and electrical properties. Paper defects. Variables affecting paper properties. Raw Material Preparation: Debarking. Chipping. Chip screening. Storage. Pulping: Chemical, Semi-chemical. Mechanical, Chemi-mechanical. Non-conventional, Secondary fibre pulping. Advances and recent trends in pulping. Chemical Recovery: Composition and properties of black

liquor. Oxidation and desilication. Concentration of black liquor and its incineration. Causticizing and clarification. Sludge washing and burning. Bleaching: Objectives of bleaching. Bleachability measurement. Bleaching chemicals and their production. Single and multi-stage bleaching processes. Bleaching of chemical and mechanical pulp. Colour reversion of bleached pulp. Control procedures in bleaching. Biobleaching. Recent trends in bleaching technology. Water reuse and recycle in bleaching.

TCH 516: Sugar Technology (2 Units; E; LH 30)

Sugar industry in Nigeria. Sugar worldwide views. Sugarcane and Sugar Beet: Production quality. Indigenous Technology for Small-Scale Sugar Production. Raw Sugar Manufacturing: Unit operations. Juice extraction. Purification. Heating. Evaporation. Crystallization, crystallization in motion. Refining: Affination. Clarification. Decolourisation. Crystallization. Centrifugation. Drying. Bagging, Storage. Factors affecting sugar processing. Quality criteria: Raw and refined sugar. Specialty Sugar Products: Brown or soft sugar. Liquid sugar. Sugar industry by-products and their uses. Sugar Chemistry, Sucrose: Structure, physical & chemical properties. Uses of sucrose. Food applications. Feedstock for chemical synthesis. Fermentation feedstock. Pharmaceutical applications, nutrition & health aspects and metabolism of sucrose. Sugar Analysis: standards & definitions. Physical methods of sugar analysis. Polarimetry. Refractive index. Colourimetry methods. Enzymatic methods. Chromatographic methods. NIR, determination of other components. Moisture, ash & inorganic constituents. Particle size distribution, insoluble matter

TCH 517: Polymer Science and Engineering (2 Units; E; LH 30)

Application of engineering fundamentals to the preparation and processing of polymers with emphasis on the relationship between polymer structure and properties. Polymer synthesis techniques. Characterization of molecular weight. Crystallinity. Glass transition. Phase behaviour. Mechanical properties. Visco-elasticity. Survey of polymer processing operations with emphasis on the application of polymer rheology and transport phenomena to predict performance, including polymer rheology and constitutive equations, mixing, extrusion, film blowing, blow moulding, injection moulding, compression moulding, coating flows, fibre spinning, thermoforming and composites processing.

TCH 518: Membrane Technology (2 Units, E; LH: 30)

Introduction, classification, membrane processes, principle, theory, membranes and materials, membrane selectivity, modules, concentration polarization, membrane fouling and cleaning, applications. Mechanism of membrane transport, RO/UF transport, solution diffusion model, dual sorption model, free volume theory, pore flow model, resistance model, boundary layer film model, membrane modules, flat, cartridge, spiral wound, tubular, hollow fiber, design equations, applications. Membrane preparation techniques-isotropic membranes, anisotropic membranes, metal membranes, ceramic membranes, liquid membranes and bio-membranes. Evaporation and gas separation, principle, theory, process design, applications, complete mixing model (binary and multi component) for gas separation, cross flow model, counter current flow model. Engineering aspects of membranes, cascade operation, examples of cascade operation, design of gaseous & liquid diffusion membrane module. Hybrid membrane techniques, membrane reactor, membrane distillation, membrane extraction and osmotic distillation, design equations, applications.

TCH 519: Process Integration (2 Units; E; LH 30)

Introduction to process integration. Role of thermodynamics in process design. Targeting of energy, area, number of units, and cost. Super targeting. Concept of pinch technology and its application. Heat exchanger networks analysis. Maximum Energy Recovery (MER) networks for multiple utilities and multiple pinches. Design of heat exchanger network. Heat integrated distillation columns. Evaporators. Dryers and reactors. Waste and waste water minimization. Flue gas emission targeting. Heat and power integration. Case studies. Maximizing the sustainability of industrial systems, the optimal exploitation of oil reserves, new approaches to the modelling of reservoirs.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

TCH 521: Process Safety and Loss Prevention in Industries (3 Units, C; LH 30)

Review of some major accidents in process industries. Hazard Identification. Hazard types. Assessment and Control. Introduction to Process Safety Engineering. Loss Prevention. Toxic Materials. Dose and Response Curves. Threshold Limit Values and Permissible Exposure Levels MSDS's. Monitoring of Volatile Toxicants. Toxic Release and Dispersion Models -Pasquill-Gifford Plume and Puff Models. Fires and Explosions. Flammability of liquids and vapours. Explosions - Detonations and Deflagrations. Fire and Explosion Protection and Prevention-Inerting, Purging Static Electricity. Explosion Proof. Equipment Ventilation. Sprinklers. Hazard Identification Checklists. DOW Fire and Explosion Index. Hazard and Operability studies (HAZOP). The layer of protection Analysis. Risk Assessment - Probability Theory. Interactions between units. Event Trees. Fault Trees. Accident Investigations. Process Safety Management – FMA, CIMAH, SEVESO Directives, PSM.

TCH 522: Environmental Pollution and Control (2 Units; C; LH 30)

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

TCH 523: Coal Processing (2 Units; E; LH 30)

Origin and formation of coal. Constituents of coal. Important properties of coals. Classification of coal. Rank of coal. Coal processing: Fundamentals of coal carbonization. Combustion. Pyrolysis. Co-pyrolysis with biochar. Gasification and liquefaction. Separation. Catalyst/catalytic reactions. Coal utilization: Products from carbonization (solid and volatile products). Chemicals and fertilizers from coal. Environmental aspects: Fly ash, SOx and NOx control strategies during combustion and after combustion. Product gas cleaning and energy utilization. Removal of H_2S, NH_3, tar, and suspended particulate matter.

TCH 524: Petroleum Processing and Petrochemical (2 Units; E; LH 30)

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

TCH 525: Bio Refinery Engineering (2 Units, E; LH: 30)

Cellulosic biomass pre-treatment: Hydrolyse, fermentation, chemical treatment. Lignin pre-treatment: radical and chemical pre-treatments. Gasification of biomass – Syngas production and valorization. Biogas from waste, residual biomass, environmental issues

TCH 526: Fermentation Technology (2 units; E; LH: 30)

Introduction: Fermentation. Types of fermentations. Role of microorganisms and other conditions on fermentation. Raw Materials for fermentative production of alcohol: Molasses- Composition. Storage. Spontaneous combustion. Grades and classification of molasses. Clarification of molasses. Other Saccharine Materials: Cane juice. Beet] juice. Sweet sorghum. Manhua flowers. Fruits' juices. Starchy and Cellulosic Materials. Isolation and purification of cultures. Outline of alcohol production by batch fermentation process. Alcohol production by continuous fermentation process. Modern Techniques of Fermentation: Batch. Semi-continuous. Continuous (Biostil, Multicont or Cascade, Encillium). Melle- Bionet process of yeast Cell Recycling. Bacterial Fermentation & immobilised Cell Technique. etc. Production of industrial and power alcohol by azeotropic distillation. Membrane technology and molecular sieves. Production of grain spirit. Chemical control. Theoretical Yield. Fermentation & Distillation. Efficiency, etc. including calculation.

TCH 527: Cement Technology (2 Units; E; LH: 30)

Description of the equipment and considerations of the process and operations involve in the manufacture of cement. Energy recovery. Historical outline. Introduction to Cement chemistry. Raw materials for cement production. Composition of cement raw mix. Sintering and chemistry of sintering. Technology of production of clinker and cement. Types of cement. Hydration of cement.

TCH 555: Chemical Engineering Research Project (4 Units C: PH 180)
Individual research projects under the supervision of an academic staff. Projects should focus on national and state industrial problems

DEPARTMENT OF CIVIL ENGINEERING
Bachelor of Engineering (B.Eng.) in Civil Engineering

1. OVERVIEW OF DEPARTMENT OF CIVIL ENGINEERING

The Department of Civil Engineering of Michael Okpara University of Agriculture, Umudike was established to adopt the technical, vocational education and training (TVET) module in order to produce self-reliant graduates who are well grounded in a broad sense in theoretical and practical aspects of Civil Engineering, in universities, industry or private practice. The programme is also designed to develop the entrepreneurial capabilities of the students for economic development. The Department of Civil Engineering offers Honours Degree in Bachelor of Engineering (B. Eng) in Civil Engineering. The duration for the degree programme in the department is five (5) years of ten (10) semesters. The course is concerned with the planning, design, construction, maintenance and environmental impact of buildings, roads, airports, waterways, railways, bridges, tunnels, docks, offshore structure, dams, water supply, drainage and irrigation systems/schemes, and other major works. The Programme in Civil Engineering is designed to produce engineers that can meet the challenges in the afore-mentioned areas through service in governmental agencies/establishments, the building and construction industry.

The structure of Civil Engineering courses as taught in Michael Okpara University of Agriculture Umudike is such that the students are introduced to and engaged in the core curriculum in line with global standard. Additional courses are added to the courses suggested by accreditation standards in such a way as to facilitate a complete civil engineering graduate that is up-to-date with the current global advancement drive. The Students Work Experience Programme (SWEP) is incorporated in over a period of eight-weeks during the long vacation and the Students Industrial Work Experience Scheme (SIWES) in over a period of six consecutive months after the First semester of 400 level, and is spent in the industries.

2. PHILOSOPHY

The philosophy of the Civil Engineering programme at Michael Okpara University of Agriculture, Umudike, is grounded in the holistic development of engineers who are not only technically proficient but also socially responsible and environmentally conscious.

3. OBJECTIVES

The programme seeks to contribute effectively and sufficiently to the knowledge, economy and food security through:

1. Broad-based foundation in Engineering and Technology as well as specialized knowledge and practice in a particular area of Civil Engineering.
2. Practical exposure to application of Civil Engineering principles to problem solution to Sustainable Development Goals (SDGs).
3. Adequate training in human and organizational behaviour and management.

4. Enhancing of entrepreneurial and mechanized Agricultural knowledge anchored on the Michael Okpara University of Agriculture Umudike vision and a spirit of self-reliance.
5. Nurturing of partnership between the institution, industry and the immediate community for effective programme delivery.
6. Creating an awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society.
7. Creating an awareness and understanding of the need to develop leadership and team building skills to maximize the benefits of an engineering education and its application to solving problems.

4. ADMISSION AND CORENINDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2)sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.
- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.
- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.
- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75% of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria

(COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineering Society	1	C	15	-
CHM113	General Chemistry I	2	C	30	-
CHM114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
*FRE 114	Elementary French I	1	E	15	
*GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 121	Introduction to Civil Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM121	General Chemistry II	2	C	30	
CHM124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	
IGB 121	Readings and Practice in Igbo	1	C	15	-
*FRE 124	Elementary French II	1	E	15	
*GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

***E= Elective**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 211	Civil Engineering Drawing	2	C	15	45
GET 211	Applied Electricity I	3	C	30	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**
200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 221	Concrete Technology	2	C	15	45
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials I	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C	-	135
	Total	**19**		**225**	**180**

*** All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 311	Fluid Mechanics	3	C	45	45
CEE 312	Structural Mechanics I	2	C	30	-
CEE 313	Soil Mechanics I	3	C	45	-
GET 311	Engineering Statistics and Data Analytics	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
	Total	**22**		**300**	**135**
300 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 321	Engineering Survey and Photogrammetry 1	2	C	15	45
CEE 322	Design of Structures	2	C	30	-
CEE 323	Civil Engineering Materials	2	E	15	45
CEE 324	Engineering Geology	2	E	15	45
CEE 325	Strength of Structural Materials	2	C	30	-
GET 321	Engineering Economics	3	C	45	-
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technology	3	C	30	45
*GET 329	SIWES 1I	3	C	-	180
	Total	**22**		**225**	**180**

*** All SIWES credited in the 2nd Semester of 400-Level**

400 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 411	Engineering Survey and Photogrammetry II	3	C	30	45
CEE 412	Principles of GIS and Remote Sensing	2	C	30	-
CEE 413	Reinforced Concrete Design	2	C	30	-
CEE 414	Numerical Methods and Operations Research	2	C	30	-
CEE 415	Engineering Hydraulics	2	C	15	45
CEE 416	Highway Engineering	2	C	30	-
CEE 417	Water Resources and Environmental Engineering I	2	C	30	-
CEE 418	Soil Mechanics II	2	C	30	-
	Total	**17**		**225**	**90**
400 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 421	Civil Engineering Laboratory	1	C		45
GET 421	Engineering Project I	2	C		90
GET 422	Engineering Valuation and Costing	2	C	30	-
*GET 229	SIWES I	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
	Total	**16**	**C**	**30**	**630**

*** All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 511	Engineering Hydrology	2	C	15	45
CEE 512	Theory of Plates and Shells	2	E	30	-
CEE 513	Water Supply and Waste Water Engineering	2	E	30	-
CEE 514	Drainage and Irrigation Engineering	2	C	30	-
CEE 515	Design of Steel and Timber Structures	2	C	30	-
CEE 516	Traffic Engineering	2	E	30	-
CEE 517	Foundation Engineering	2	C	30	-
CEE 518	Modern Transportation Engineering	2	C	30	-
CEE599	Project	6	C	-	270
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
	Total	**17**		**240**	**45**
500 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CEE 521	Construction Engineering	3	C	45	-
CEE 522	Public Health Engineering	1	C	15	-
CEE 523	Highway/Transportation Engineering II	2	E	30	-
CEE 524	Dynamics of Structures	2	C	15	45
CEE 525	Structural Mechanics II	2	E	30	-
CEE 526	Water Resources and Environmental Engineering II	2	E	30	-
CEE 527	Geotechnical Engineering	2	E	30	-
CEE 599	Project	6	C	-	270
GET 521	Engineering Management	3	C	45	-
	Total	**17**		**150**	**315**

CEE599 credited in the 2nd Semester of 500-Level. Do at least 1 elective in each semester

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Units C: LH 30)
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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat,

viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

STA 112: Probability I (3 Units C: LH 45)
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

GST 111: Communication in English (2 Units C: LH 30)
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, generalization and explanations). Ethical considerations, copyright rules and infringements. Writing activities: pre-writing (brainstorming and outlining).Writing (paragraphing, punctuation and expression).Post- writing (editing and proofreading).Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups).Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria).Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence).Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War).Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance).Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

LIB 116: Use of Library (1 Unit C: LH 15)
Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library

and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, QuelquesverbesutilisentdansL’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologied'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), GénieCivile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L’heure, Les

jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit *E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Info]rmation, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

CEE 121: Introduction to Civil Engineering (2 Unit C: LH 15)
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.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations).Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design Thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)
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.

GET 123: Engineering Laboratory I (1 Unit C: LH 15 PH 15)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of vernier calipers, micrometersa and multimeters. Force, Equilibrium and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement:

Oscilloscope and Signal Generator Use. Overview of robotics components.DC motor and servo motor control using motor drivers (e.g., L298N).Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)

Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens's principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**

This practical course is a continuation of PHY 117 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.

ENG 121: Use of English (1 Unit C: LH 15)

Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)

Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit *E: LH 15)

LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit *E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

CEE 211: Civil Engineering Drawing (2 Units C: LH 15; PH 45)
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.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modelling II (2 Units C: LH15; PH 45)
Projection of lines, auxiliary views, and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface, and shell modeling. Faces, bodies, and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries, and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting, and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)
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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)
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.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship).Basic principles of e-commerce.

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

CEE 221: Concrete Technology (2 Units C: LH 15; PH 45)
Introduction to concrete, its components and use. Chemical admixtures applied to concrete. Properties of fresh concrete, Properties of hardened concrete. Test methods- Concrete mix design.

Quality control Transportation, policing, co-proofing of concrete and joints in concrete construction. Special concrete. Ready mix concrete, fiber-reinforced concrete, precast concrete and high-performance concrete. Practical skills to be developed include Select the proper method of analysis; Measure the quantities accurately; Handle instruments properly; Analyze given data; Interpret the results. Semester work shall consist of experiments covering physical tests on cement, mix design of normal concrete mixes, and workability tests. Compressive strength of concrete using test cubes and cylinders. Non- destructive test (NOT).

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)
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 operator's 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 222: Engineering Materials (3 Units C: LH 45)
Crystal structure of selected specimen (BCC, FCC, HCP).Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing. Heat treatment processes hardening & tempering. Microstructural examination of mild steel. Comminution devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal Conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and non-destructive test of engineering materials, testing of magnetic materials e., g. transformer cores, testing of insulators, cables and transformers coil, and verification of P-N junction characteristics. Tensile tests on bars, Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring adiation. Proximate Analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and non-destructive test of engineering materials, testing of magnetic materials e., g. transformer cores, testing of insulators, cables and transformers coil, and verification of P-N junction characteristics. Tensile tests on bars, Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring, composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 223: Engineering Mathematics II (3 Units C: LH 45)
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 224: Strength of Materials (3 Units C: LH 45)
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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronic Engineering Laboratory (1 Units C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227 Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines,

welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

CEE 311: Fluid Mechanics (3 Units C: LH 30; PH 45)

Types of fluid flow. Fluid statics: Floatation and stability. Dynamics of fluid flow - conservation equation of mass and momentum. Euler and Bernoulli's equations. Introduction to incompressible viscous flow. Application of Bernoulli's equation to fluid measurement, pitot tubes, orifices, nozzles, venturimeters, weirs, notches and rate meter. Types of machines, impulse and reaction turbines; Pelton wheels; Francis Turbines. Unit speed, unit discharge, unit power performance characteristics of pumps and turbines. Specific speed multi-stage pumps. pumping and piping. Dimensional analysis using Buckingham Pi theorems. Potential viscous flow and shear forces in pipes and between parallel plates. Reynolds number, laminar and turbulent velocity distribution, laminar flow between parallel plates and through circular tubes, boundary layers and separation. Drag and lift.

LABORATORY PRACTICALS: Reynolds experiment, Calibration of V-notch, Orifice meter, Venturimeter, Bernoulli's, experiment, Flow in single pipes. Unsteady flow in pipes with special emphasis on water hammer and use of surge tanks. Pressure estimation on sphere, cylinder, flow visualization, Wall friction. Minor pipe losses. Equation for radial pressure variation. Radial flow. Free vortex flow. Forced vortex flow. Secondary flow in beds. Flow measurements. Flow meters and errors in measurement.

CEE 312: Structural Mechanics I (2 Units C: LH 45)

Introduction to statically determinate and indeterminate structures, geometrical redundancy, geometrical constraints, primary system, degree of geometrical redundancy. Analysis of determinate structures - beams, trusses; structural analysis theorems, graphical methods; application to simple determinate trusses for reactions, shear force, moments and deflections. Advanced topics in bending moment and shear force diagrams in beams, Arches, Frames and compression bridge structures. Theory of bending of beams and deflection of beams. Unsymmetrical bending and shear centre and applications. Strain energy. Biaxial and triaxial state of stress. Transformation of stresses. Mohr's circle. Springs. Creep, fatigue, Fracture, stress concentration and failure theories. Influence lines for statically determinate structures: beams, trusses and arches. Theorem of three moments and Claperon's method of indeterminate structures.

PRACTICAL SESSION: Analysis of elastic line of statically determinate beams. Determination of reactions in simple portal frame (Compression bridges) and three pinned arch. Shear Centre Determination. Determination of deflection of cantilever bent in a plane which is not symmetrical. Experimental stress analysis; mechanical and optical strain measuring devices. Electrical strain gauges' photo elastic strain measurement. Brittle coating

CEE 313: Soil Mechanics I (3 Units: LH 30; PH 45)

Mineralogy of soils and soil structures. Formation of soils, soil classification, engineering properties of soils. Soil in water relationships - void ratio, porosity, specific gravity, permeability and other factors. Atterberg limits, particle size distribution, Shear strength of soils and Mohr's stress circle.

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)

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

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

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

GET 313: Engineering Mathematics III (3 Units C: LH 45)

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

GET 314: Engineering Laboratory III (AI driven IoT& Data Analytics) (1 Units C: PH 45)

Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP).Sensors, Actuators, and Embedded Platforms (Arduino, ESP32, Raspberry Pi).Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlowLite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning,

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

GST 312: Peace and Conflict Resolution (2 Units C: LH 45)

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

CEE 321: Engineering Surveying and Photogrammetry I (2 Units C: LH 15; PH 45)

Introduction to theory and practice of land surveying. Distance: linear measurement and correction. Chain surveying techniques-ranging, taping etc., Compass surveying-direction of local attractions and adjustments problems based on intersection and radiations. Leveling instruments and leveling techniques-height of instrument method and the rise and fall methods. Geodetic levelling - errors and their adjustments. Applications. Tachometry - Methods: Substance heighting. Self-adjusting and electromagnetic methods. Introduction to longitudinal cross section, contour and their uses. Traversing; Temporary adjustments- Bowditch and the transits methods of reduced bearing and whole circle bearing. Use of hand operated and electronics machines. Application of traversing to setting out of funnels pipe lines etc. Leveling; Errors in Engineering leveling. Geodetic (precise) leveling collimation errors and adjustments. Bandwith methods of adjusting lines of levels. Application to setting out of sewer using boning rod etc. Tacheometry;

Tachometry methods for incline lines of sights. Topographic mapping; Substance heighting (but not including simultaneous reciprocal observations) study of self-reducing tachometer and Electromagnetic distance measuring equipment.
LABORATORY PRACTICALS: Chain surveying exercise, Compass traverses, running lines of levels and elementary sectioning and theodolite tasks. Practicals in field surveying related to Engineering projects. Location and setting out of works, roads, bridges, railways, tunnels, pipelines and buildings. Hydrographic surveying. Compass traverse, running lines of levels, sectioning and use of Theodolite.

CEE 322: Design of Structures I (2Unit C: LH 30)
Fundamentals of design process, materials selection, building regulations and codes of practice; design philosophy. Elastic design, limit state design, of structural elements in reinforced concrete.

CEE 323: Civil Engineering Materials (3 Units C: LH 30; PH 45)
Introduction to Civil Engineering Materials: Concrete technology; Manufacture and properties of cement, aggregates and their properties; types of cement; properties of fresh and hardened concrete. Concrete mix design. Properties and their determination. Effects of water/cement and aggregate/cement ratios on strength of concrete; Steel technology- production, fabrication and properties, corrosion and its prevention. Test on steel and quality control. Timber technology – types of wood, properties, and uses of timber. Defects in timber. stress grading. Preservation and fire protection. Timber products. Rubber, plastics, asphalt, tar, glass, lime pricks mud etc. Bituminous material, properties and uses. Soils, formations, exploration and sampling of soils, brick work and block work, Polymers in Civil Engineering practice. Application of civil engineering materials to buildings, roads and bridges.
LABORATORY PRACTICALS: Various tests on cement, specific gravity of construction materials, destructive and non-destructing tests for concrete, test on timber structures, characteristics strength test for steel.

CEE 324: Engineering Geology (2 Units C: LH 15 PH 45)
Introduction. Scope and subdivision of geology, relevance to civil engineering, origin and evolution of the planets, the earth and its relation to the sun and other planets. Rocks and minerals. Stratigraphy - time scale - fossils and their importance: special reference to Nigeria. Introduction to geology of Nigeria. Engineering Applications - Water supply, site investigation - Dams, Dykes, etc. The core, the mantle and the crust, composition of the various layers. Radioactivity and magnetism of some rocks and minerals. Geological processes. Exogamic processes. (Weathering and erosion) Endogenic processes. Magma- its origin, crystallization differential; and solidification into rocks-earthquakes, volcanoes rifting and continental drifts. Folding, faulting, jointing and rifting. Isostasy, changes in static sea levels, causes and effects; transgression and regression tectonic and sedimentation. Historic geology and stratigraphy. Geological time scale. Fossils, type of unconformities; and fossils records in Nigeria's sedimentary rocks. Introduction to the geology of Nigeria: the basement complex, the cretaceous and younger sedimentary rocks. Major soil types and their distribution. Mineral resources of the earth: properties of minerals; minerals types, fossil fuels, organic minerals, non-metallic minerals resources of Nigeria with particular emphasis on origin of petroleum. Physical state of hydrocarbons, migration, accumulation and exploitation. Minerals in the economy of Nigeria.
LABORATORY PRACTICALS: Study of geological map, physical properties of minerals, Rocks identification, folding, faulting.

CEE 325: Strength of Structural Materials (2 Units C: LH 30)
Advanced topics on axial, lateral, and torsional loading of shafts and beams; slope and deflection of beams; unsymmetrical bending and shear centre; applications. Springs. Creep, fatigue, fracture and stress concentration. Stresses in thin and thick cylinders, and rotating disks. Multi-dimensional stress systems, Mohr's circle and failure theories.

GET 321: Engineering Economics (3 Units C: LH 45)
The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics.Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity, Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost, Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Acccounting Concepts-Double Entry system, Journal, Ledger, Trail balance, Final Accounts Book Keeping system, Depreciation - Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization).Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A, B, C, D, E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report).Language and organisation of reports. Technical report writing skills (steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports (competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 323: Engineering Mathematics IV (3 Units C: LH 45)
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturm-Liouville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and

Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. Runge-Kutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

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

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solid works: software capabilities, design methodologies and applications. Basics part modelling: sketching with Solid Works, building 3D components, using extruded Bose base · Basic assembly modelling, and solid works drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

1. Design of machine components;

2. Product design and innovation;
3. Part modelling and drafting in Solid Works; and
4. Technical report writing.

CEE 411: Engineering Surveying and Photogrammetry II (3 Units C: LH 30; PH 45)
Topographic maps/plans; Basic principles of contour and contouring, Further work on contours and contouring - methods of contouring, contour interpolation and uses of contour plants and maps, areas and volumes. Direct and indirect method of contouring. Setting out of engineering works. Elementary topographical surveying. Elements of Photogrammetry, photogrammetric equipment, errors of measurements and contour interpolation. Uses of contour maps/plans e.g. to determine areas and column of reservoirs and locate proposed routes. Setting out of Engineering works: Basic principles of setting out. Method of setting out various Engineering works- Base lines, sewers, laying the pipes, bridges, reference mark curves (horizontal and vertical) vertical alignment (controlling vertical in multi-storey building, transferring height from the floor to floor) setting out of building lines, roads, and highways. Monitoring of structures, control of excavating process. Construction surveying; Basic principle of construction surveying. Explanation of various surveying works involved in the construction of highways, streets, railways, canal, pipelines, tunnels, bridges, sites, dam etc. Photogrammetry. Mass-haul diagrams. Area and volume of earthworks. Determination of areas by approximate methods-calculating areas from coordinates, from triangle and area of irregular boundary (trapezoidal method). Volume of earthworks; the prismoidal method, volume from road profile, volume from irregular cross-section from sport heights and volume from contour maps. The prismatic correction. Elements of photogrammetry.
LABORATORY PRACTICALS: Photogrammetry equipment and errors of measurement. Identification of features in air photographs, viewing of photographs with pockets and mirror stereoscopes plotting of site plans by bearings and distance and from coordinates by use of AutoCAD and MICROSTATION SE Software. Applications.

CEE 412: Principles of GIS & Remote Sensing (2 Units C: LH 30)
Electromagnetic radiation and interaction with matter. Types and design of electromagnetic sensors. The photographic camera, Radiometers, thermal scanners, and multispectral scanners. Sensor platforms. Introduction to digital image processing. Image classification. Elements of photo interpretation. Definitions and Basic concepts of GIS (Geographical Information System).Spatial relationships. Elementary Mathematical concepts (graph theory, set theory, and topology). Components of a GIS. Field-based and object-based concepts of the real world. Raster and vector databases. Spatial Data Models: 2D, 3D, and 4D Model; tessellation data models; vector data models, tessellation versus spatial vector relationships: metric, topologic and spatial order. Data quality aspect: positional accuracy, attribute accuracy, logical consistency, completeness, and lineage. Data capture; data manipulation; data queries, data analysis; data modelling; data display and data presentation.

CEE 413: Reinforced Concrete Design (2 Units C: LH 30)
Fundamentals of design process, properties of reinforced concrete materials building regulations, materials selection and codes of practice. Design philosophy, elastic design: limit state designs in concrete, principle of modular ratio and load factor method. Theory of design of basic structural reinforced concrete elements for bending and shear using ultimate strength design methods. Design

of beams and slabs for flexure, shear, anchorage of reinforcement, and deflection. Design of columns for axial force and foundation base and bending schedule.

CEE 414: Numerical Methods and Operations Research (2 Units C: LH30)

Operations Research, Optimization models, Methodology for modeling real-life problems into mathematical programs - Examples and applications, Linear, Integer, Network, and Nonlinear Programs - Algebraic modeling - Algebraic modeling software - Optimization software, Optimization methods, Outcomes of optimization problems - Graphical solution of optimization problems - The improving search paradigm - Local and global optima - Convexity - Enumeration methods - Commercial solvers, Nonlinear Programming, Review of calculus (gradient, Hessian, Taylor expansion) - Improving feasible directions - Optimality conditions (necessary and sufficient) for unconstrained and constrained problems - Finding initial feasible solutions - Iterative methods for optimization problems – Convexity, Linear Programming, Modeling strategies and assumptions for linear programs - Graphical solutions to linear programs - Polytopes - Extreme points and extreme rays - Simplex algorithm - Convergence of Simplex - Degeneracy - Primal and dual bounds for Linear Programming - Duality theory - Sensitivity analysis and post-optimal analysis, Network Programming, Introduction to networks - Modeling strategies and assumptions for network programs - Total unimodularity - Shortest path - Dijkstra's algorithm - Maximum flow modeling - Ford-Fulkerson algorithm - Max-Flow-Min-Cut Theorem – Matching, Integer Programming, Modeling strategies and assumptions for Integer Programs - Difficulty of Integer Programs – Graphical solutions of IPs - Total enumeration - LP relaxations - Rounding techniques - Divide-and-Conquer schemes - Branch-and-Bound - Cutting Planes.

CEE 415: Engineering Hydraulics (2 Units C: LH 15 PH 45)

Pipe Networks. Branching pipes. Hardy cross method of pipe network analysis. Computer application in the development of pipe network analysis. The use of Excel, Matlab and other commercial pipe network software like EPANET. Water hammer and surges in pipe flow network. Fundamental concepts of fluid flow. Laminar and turbulent Flow. Boundary layer separation Lift and Drag. Stream function, velocity potential application to flow Nets. Steady and Unsteady flow in a closed conduit. Uniform flow open channels: open channel, uniform flow, hydraulic mean depth, hydraulic gradient, broad-crested weir and centurial flume, force equation, best hydraulic section. Non-uniform flow in open channels: energy equation for open streams, specific energy, critical velocity and critical depth, hydraulic jump, backwater curves. Surge waves. Hydraulic models: hydraulic design criteria, problems of reservoirs, river training and regulations, transition structures. Dams; weirs, spillways, gates and outlet work, stilling basins. Cofferdams, breakwaters, moldes, surge tanks. Design of open channels, conduit systems and hydraulic machinery. Design of municipal storm drains, land drainage systems and culverts and bridges. Hydraulic model. Purpose of models, laws of similitude, types of models and practical model scales, Sediment transport formulae, " land drainage and inland navigation problems. Definition of hydrology. hydrologic cycle and components. Precipitation, radiation, wind, evaporation, transpiration, infiltration, percolation, runoff, catchment and watershed characteristics. Measurements of hydrologic cycle components. Water balance equation with worked examples. Surface water hydrology.

LABORATORY PRACTICALS: Performance curves of pumps and turbines; Unsteady flow in surge chamber. Friction losses in pipes and fittings; Measurement of flow velocity/discharge in laboratory flumes; Measurement of incipient motion of particles in laboratory. Determination of Reynolds numbers at different flood rates in laminar/turbulent flow phenomena, to determine unsteady flow in surge chambers, to conduct model studies in a wind tunnel.

CEE 416: Highway Engineering (2 Units C: LH 30)

Introduction – general transportation systems. Highway economic and financing. Road classification. Highway location survey. Earthwork calculations. Geometric design of highways including intersections. Axle load surveys and calculation of traffic loads. Soil engineering aspects of highways-compaction soil stabilization. Pavement materials and laboratory tests. Pavement structures and design. Highway drainage and design, highway maintenance. Airport engineering-classification of airports and aircraft characteristics. Airport terminology, planning and design of airports. Airports-introduction to railway engineering. Location surveys and alignment, railroad structures and design.

CEE 417: Water Resources And Environmental Engineering2 Units C: LH 15; PH 45)

Engineering economy in water resources planning. Drainage. Hydrograph analysis, reservoir and flood routing, and Hydrological forecasting. Hydraulic structures, etc. Dams, dykes, weirs, docks and harbour, spillways, stilling basins, man-holes Mid coastal hydraulic structures etc. Board crested: Weir-calibration, discharge coefficients. Sharp-crested weir, venture flumes. Hydraulic jump and backwater curves, scour behind bottom revetment and around bridge piers, instability of sorts due to groundwater flow, experiment with laminar flow table. Basic water and wastewater sampling and analysis – Dissolved oxygen, BOD, COD, Hardness, Nitrogen (Kyeldah and organic), iron and manganese, plate count coliform group.

CEE 418: Soil Mechanics II (3 Units C: LH 30; PH 45)

Formation of soils, soil deposits, soil properties. Soil and water relationship – void ratio, porosity, specific gravity and other factors. Soil classification. Atterberg limits – particle size distribution. Flow of water in soils – seepage and permeability and ground waterflow.

LABORATORY PRACTICAL: Laboratory soil tests include classification, permeability and index tests: liquid limit, plastic limit, Atterberg limits. Determination of specific gravity, void ratio, porosity, particle size distribution, direct shear, triaxial, and consolidation tests. Soil classification test: Insitu density tests compaction and C.B.R. tests, identification of rock and rock materials physical and engineering properties or rocks. Terzaghi Bearing capacity, identification and physical properties. Soil survey and soil map study.

CEE 421: Civil Engineering Laboratory (1 Unit C: PH 90)

Identify Highway and Traffic Components: Traffic Survey Techniques: Manual and automated traffic counts (volume, speed, classification). Road Inventory Survey: Identify and document road elements (carriageway, shoulders, medians, signage, pavement markings). Intersection Components: Study of types (T, Y, cross, rotary), control devices (signals, signs), and pedestrian facilities. Field Visit / Virtual Tour: Examine an actual road or simulate highway elements using videos or CAD software. Use of GPS and GIS in Road Mapping: Map a small section of road using GPS and overlay on GIS software to identify components. Design Geometric Components of Highways: Horizontal Curve Design: Calculate radius, length of curve, and set out a simple

circular curve using theodolite or total station. Vertical Curve Design: Use given grades to design summit and valley curves, and plot their profiles using CAD or graphing tools. Cross-Section Design: Design and draw the typical cross-section of a highway with shoulders, medians, drainage. Sight Distance Analysis: Determine SSD, OSD, and ISD on a road segment and evaluate field data accordingly. CAD Software Application: Use AutoCAD Civil 3D or similar for drafting alignments and geometric elements. Evaluate Strength of Construction Materials: Aggregate Crushing Value Test: Determine the strength of aggregates used in road construction. Los Angeles Abrasion Test: Assess the hardness and wear resistance of aggregates. CBR Test (California Bearing Ratio): Measure the subgrade strength for pavement design. Bitumen Testing: Penetration, ductility, and softening point tests for road bitumen. Concrete & Cement Testing: Compression strength test of concrete cubes, initial and final setting time of cement. Apply the Optimization of Strength of Materials: Concrete Mix Design Lab: Optimize mix ratios for different grades of concrete (using IS/ACI methods). Compaction Test: Proctor test to optimize moisture content for maximum soil compaction. Flexural Strength of Beams: Conduct flexural strength tests on beams and analyze the effects of reinforcement. Tensile and Compression Testing: Use UTM (Universal Testing Machine) to test different materials (steel, concrete, etc.) under load. Non-Destructive Testing (NDT): Rebound hammer or ultrasonic pulse velocity test to assess in-situ concrete strength.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

GET 421 Engineering Project I (2 Units C: PH 90)

In the second semester of the 400-level students, preferably in groups, work from the university on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422 Engineering Valuation and Appraisal (2 Units C: LH 30)

Objectives of valuation work/valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices.

Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

CEE 511: Engineering Hydrology (2 Units C: LH 30; PH 45)

Hydrological cycle, rainfall, and measurement of rainfall and analysis of rainfall, evaporation: measurement of evaporation, formulae and theories, their use and applications. Infiltrations: The role of infiltration in hydrological cycle, infiltration as factor of runoff and as recharge of ground water, comparison of methods of estimating infiltration. Drainage basins and hydrographs monthly and annual runoff relations, characteristics of drainage basin and hydrograph analysis. The unit hydrograph: Basic principles, unit hydrographs for various durations, derivation of unit hydrographs from complex storms, synthetic unit hydrograph. Flood routing: routing in a simple reservoir stream flow. Routing, frequency and duration studies.Hydraulics of wells, groundwater investigations and exploration for water. Groundwater and Aquifers: Physical Properties of Aquifers. Darcy's Law and Hydraulic conductivity. Well Flow Systems: Measurement of hydraulic conductivity, Transmissivity, Specific yield and storage coefficient. Groundwater Exploration, well construction and pumping. Mathematical Techniques – Analytical and numerical solutions and simulation. Digital Computers – Finite Difference and Finite Element techniques in groundwater modelling. Unsaturated Flow. Surface – Subsurface water relations. Computer Aided Design in Water Resources

CEE 512: Theory of Plates and Shells (2 Units E: LH 30)

This course covers classical theories related to coordinates and vector formulations, along with fundamental engineering applications. The focus is on comprehending the geometrical load-carrying properties of plate and shell structures, as well as interpreting numerical solutions. It addresses numerical methods such as the Rayleigh-Ritz technique, along with theories for both small and large deflections of plates. The course explores stresses and deformations in shell elements and applies Kirchhoff assumptions to thin plate theory. Additionally, it includes membrane bending theories of thin shells and analyzes plates and shells through both classical and refined plate theories to tackle static and dynamic issues.

CEE 513: Water Supply and Waste Water Engineering (2 Units C: LH 30)

The relationship between water and wastewater is crucial, especially concerning public health and waterborne diseases. Key components of water chemistry play a significant role in this context. Treatment methods are implemented for both surface water and groundwater. Fundamental design principles are essential for creating water supply treatment and distribution systems, which encompass storage, pumping, and piping. Wastewater originates from various sources, and surveys can differentiate between industrial and domestic wastewater. Understanding wastewater involves microbiological elements, as well as the design and processes involved in its collection, treatment, and disposal. There are also options and alternatives for reusing wastewater, alongside effluent standards that must be followed. In terms of sewage, important considerations include the quantity and quality of sewage, identifying crucial parameters for measurement. Planning, designing, constructing, and maintaining sewage systems are essential tasks. Treatment processes for sewage include various unit operations, as well as non-conventional methods such as sewage farming, waste stabilization ponds, aerated lagoons, and oxidation ditches. Disposal methods for sewage can be either water-dependent or independent. Effective water pollution control measures are necessary, along with assessing the quantity and quality of solid waste, including methods for collection, transportation, and disposal. Institutional frameworks must be established for efficient management, particularly concerning toxic and hazardous waste.

CEE 514: Drainage and Irrigation Engineering (2 Units E: LH 30)
Land classification: crop water requirements; Crop: irrigation requirements; farm delivery requirements; diversion requirements; soil water relationships; movement of soil moisture; measurement of infiltration and soil Moisture. Irrigation water quality. Irrigation planning criteria. Irrigation methods; supplemental irrigation, irrigation structures. Design, construction, operation and maintenance of surface, sub-surface and sprinkler irrigation systems. Surveys and investigation – sources of water, soils and salinity. Water tables; drainage structures. Subsurface drains. Design criteria – Drain size, materials used; installation of subsurface drains; urban storm drainage. Land drainage.

CEE 515: Design of Steel and Timber Structures. (2 Units C: LH 30)
Introduction to building codes. Fundamentals of load and resistance factor design of steel elements. Design of tension and compression members. Composite design and construction in steel and reinforced concrete; design of structural foundations: pre-stressed concrete design. Modern structural form: tall buildings lift shafts and shear walls, plate girders, crane girders, stanchions in multi-storey building, fire, and corrosion protection devices, system buildings: design projects. Simple connection design. Introduction to computer modelling methods. Timber design; allowable stresses, types of joint, fluid timber members, timber beams and trusses. Laboratory tests on structural elements in concrete, timber and steel, Computer Aided Design of structures. Exercises on design and detailing of connections, basic structural elements in steel and timber.

CEE 516: Traffic Engineering (2 Units E: LH 30)
Study of fundamental operational solutions to traffic problems, followed by a theoretical study of traffic stream flow and its parameters: fundamentals of highway signals and marking; signal system types and their design and operation. Studies of intersection gap acceptance flow density relationships, shock. An in-depth study and analysis of conventional and emerging public transportation state of the art systems. Brief review of conventional transportation systems, study of bus rapid systems, demand responsive bus systems, personal rapid transit, dual mode, guide way and automated freeway systems and high speed rail TACV systems. Review of current transportation administration. Systems research and demonstration programmes.

CEE 517: Foundation Engineering (2 Units C: LH 30)
Review of soil bearing capacity; consolidation and settlement. Design of shallow and deep foundations, earth pressure design, and types of retaining walls and functions. Design of gravity, cantilever, buttress and counterfort retaining walls. Design of footings, combined footing and raft foundation, design of footing subjected to moments, floating foundations. Pile foundations and pile load tests, design of pile foundations and piles subjected to lateral loads, Batter piles, Caissons and pile caps. Design of foundation structures – design and detailing of footings, combined footing raft foundations, piles sheet pile walls. Slope stability, soil structure interaction and the design of flexible bulkheads. Anchor system for various earth structures. Seepage and surcharge effects. Site investigation.

CEE 518: Modern Transportation Engineering (2 Units C: LH 30)
An in-depth study and analysis of conventional and emerging public state-of-the-art systems. The concept of planning and design of such system as waterways, air transportation, harbor and dock engineering, railway transportation and pipeline transportation. A brief review of conventional transportation systems, a study of bus rapid systems, demand responsive bus systems, personal

rapid transit, dual mode, guide way and automated freeway systems and high-speed rail TACV systems. Review of current transportation administration. Systems research and demonstration programs.

GET 511: Engineering Project Management (3 Units C: LH 45)

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

GET 512: Engineering Law (2 Units C: LH 30)

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

CEE 521: Water Resources and Environmental Engineering II (2 Units E: LH 30)

Introduction to public health engineering – the sanitary engineer's role, characteristics of water and wastewater, (physical, chemical and biological characteristics), Water supply, treatment and design. Wastewater collection, treatment, disposal and design. Solid waste collection, treatment, disposal and design of systems. Air pollution and control. Air pollution: monitoring and control, air pollutants, characteristics, sources, dispersion of pollutants in air, dispersion models, equations, design of air pollution control systems. Water pollution: types of water pollution, point sources and non-point sources, effects of pollutants on water, control and management of water pollution.

Solid waste management, classification, quantification and composition of solid waste disposal methods; environmental protection regulations.

CEE 522: Public Health Engineering (1 Units C: LH 15)

This course covers the fundamentals of sanitary engineering, focusing on the structure and growth of microorganisms along with sterilization and culture techniques. Students will explore water usage and the diseases related to water. Understanding the physical, chemical, and biological characteristics of water and wastewater, including their measurement and significance. Examination of appropriate technologies for water supply and treatment processes, including coagulation, storage, filtration, disinfection, and distribution. Onsite sanitation practices, with a focus on designing and managing various non-waterborne sanitation systems, such as traditional pit latrines and improved latrines. Study of waterborne sanitation systems relevant to the Nigerian context, including vaults, cesspools, septic tanks, and pour-flush toilets, alongside wastewater treatment strategies. Analysis of the sources and effects of pollution, along with water quality standards and control measures. Overview of air pollution agents, their effects, and control methods. Financial management and operational principles of PHE systems. Study of water supply systems, including abstraction, storage, pumping, distribution, and network analysis. Definition of water quality standards and the scientific basis for designing unit processes in water treatment. Understanding urban drainage systems, including hydraulic principles, rainfall management, storm water collection, and combined sewer systems. Defining wastewater systems, understanding sewage characteristics, and meeting effluent quality requirements. Treatment processes such as primary sedimentation, activated sludge systems, biological filters, and sludge treatment and disposal. Exploration of water sources, health implications, and waterborne diseases. Analysis of water quality through physical, chemical, microscopic, bacteriological, and radiological methods. Flow diagrams for treating surface and groundwater, covering preliminary treatment, screening, coagulation, flocculation, and sedimentation. Techniques including slow sand, rapid sand, and pressure filtration, as well as disinfection, water softening, and removal of iron and manganese. Principles of designing water supply, treatment, and distribution systems, including storage requirements. Identification and survey of sources of wastewater, encompassing both industrial and domestic origins. Students will engage in hands-on laboratory practicals to determine various water quality parameters, including:

1. Color, taste, odor, and pH levels
2. Total alkalinity and hardness (including calcium hardness and CO2 levels)
3. Concentrations of iron, magnesium, sulphate, and chloride in water.

CEE 523: Highway/Transportation Engineering II (2 Units E: LH 30)

Highway planning and traffic survey. Origin and destination studies, purpose, zoning, cordon, and internal surveys, are processing survey data. Introduction to trip generation and attraction, trip distribution, modal split and route assignment. Intersection design, types of at-grade and grade-separated intersections, assessment of intersection capacity, conflicts at intersection. Traffic management; traffic signal timing, vehicle actuation, elementary signal systems, delay studies and one-way street, design of signal timing, other traffic control systems, signs and line markings. Parking control. The management of traffic and design of traffic signals. Parking. Geometric design. Construction methods. Construction material laboratory tests.

CEE 524: Dynamics of Structures (2 Units E: LH 15 PH 45)

This course structure emphasizes the integration of theoretical knowledge with practical applications, to enhance the understanding of dynamic behavior in various structural systems considering basic principles of motion and forces, Newton's laws and their application to structures, Equations of motion for particles and rigid bodies. Free and forced vibrations of single-degree-of-freedom (SDOF) and multiple-degree-of-freedom (MDOF) systems, Damped and undamped systems, Frequency response functions and resonance (Natural frequencies and mode shapes).Types of dynamic loads (seismic, wind, impact), Static vs. dynamic analysis, Response spectra and their applications in seismic design, Time history analysis, Impulse response and transfer functions. Formulating equations of motion for SDOF and MDOF systems using Lagrange's equations, Matrix methods for dynamic analysis, Finite element methods for complex structures. Numerical integration methods (Newmark, Runge-Kutta), Time history analysis and response simulations, nonlinear dynamic analysis. Modal analysis and modal superposition method, Experimental modal analysis techniques, System identification methods. Deriving the equation of motion for an SDOF system subjected to an external force, Calculating natural frequencies and mode shapes of a simple beam using the Rayleigh method, Analyzing a multi-story building under seismic excitation using response spectrum analysis, Solving a time history analysis problem for a structure subjected to an earthquake record.

Laboratories: Hands-on experience with dynamic testing and data acquisition.

CEE 525: Structural Mechanics II (2 Units C: LH 30)

Analysis of stress and strain, phenomenological material behaviour, extension, bending, and transverse shear stresses in beams with general cross-sections. Analysis of truss, beam and frame structures using matrix methods; matrix force methods; matrix displacement method; analysis concepts based on theorem of least and virtual work in structural analysis. The analysis of framed structures, planar and 3D using beam-column elements and shear walls and floors. Flexibility and stiffness analyses performed by generating the matrices and carrying through the analyses step by step with a matrix manipulator program. Computer applications. Advanced topics in statically indeterminate continuous Frames, Arches and Compression bridges.

CEE 526: Construction Engineering (3 Units C: LH 30)

This entails earth-moving activities, machinery, capital investment, and operational expenses. It also includes formwork design, assembly of components, enhancing productivity and construction techniques, safety measures, project financing, insurance and bonding, and contractual agreements. Additionally, it addresses solutions for challenges faced on construction sites and in engineering projects, particularly in the context of buildings and heavy construction in Nigeria.

CEE 527: Geotechnical Engineering (2 Units E: LH 30)

Engineering geology. The behavior of rocks and soil in building and engineering construction, foundations, tunnels, dams and flood control work with reference to the importance of the mineral composition of earth and rock materials, their geomorphic and geological features and their stress history. Field investigation. Earth structures (earth dams) and slope stability, the choices of type of dam design, construction and control of dams, embankments and slopes. Principles of dams design, explorations, construction and materials, stability analysis, deformation prediction, groundwater control, construction procedures and equipment. Foundations subjected to dynamic forces. The initial and long-term stability of earth-retaining structures. Rock mechanics:

introduction to rock mechanics, mining engineering, and rock excavation, drilling and blasting techniques.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

CEE 599: Project (6 Units C: PH 270)

For proper guidance of the students, projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their option subjects.

DEPARTMENT OF COMPUTER ENGINEERING
Bachelor of Engineering (B.Eng.) in Computer Engineering

1. OVERVIEW OF DEPARTMENT OF COMPUTER ENGINEERING

The Computer Engineering programme is designed to prepare the computer engineering graduate to acquire the requisite skills in the learning, literacy and life domains. The learning domain highlights critical thinking, creativity, collaboration and communication while literacy focuses on information, media, and technology complemented by the life skills that demonstrate flexibility, leadership, initiative, productivity and social balance. The Computer Engineering programme is conceived to produce Engineers who can work with all aspects of computers (software and hardware) and other Engineering professionals in a world in which high-level language software, complex programmes and smart hardware are complementing and progressively replacing human effort in solving societal problems. The programme, therefore, prepares the students towards the design, analysis, and application of computers and computer-based systems in the development and production of peripheral and remote devices/computer systems to manage all economic sectors including agriculture, services, energy, infrastructure, health, environment, entertainment, sports and security. The primary areas of specialization are: Artificial Intelligence, Computer Architecture, Computer Design and Engineering, Computer Theory, Information Technology, Operating Systems and Networks, Robotics, Software Applications and Software Engineering.

2. PHILOSOPHY

The general philosophy of the Computer Engineering Department is to produce graduates with hardware, software, firmware, communication and research skills that are useful in analyzing, evaluating, designing, developing, manufacturing, procuring, marketing, managing and maintaining the computing, electronics, communication, information processing, and operating systems embedded in computer hardware and devices used by individuals, and private and public organizations.

3. OBJECTIVES

The broad objective is to produce graduates that have the requisite knowledge, skills and emotional disposition needed for a 21st century world that increasingly demands greater, more advanced, efficient, sustainable and client-centric technological solutions. Specific objectives include:

1. Applying the knowledge gained from courses in mathematics, science (social and basic), computing, and algorithmic reasoning to resolve Computer Engineering challenges individually or within multidisciplinary groups/teams;
2. Understanding and applying discrete mathematics and computational techniques
3. Defining complex engineering problems, collecting, analyzing data and problems as well as developing models and implementing solutions for engineering problems;

4. Analyzing, designing and optimally managing the hardware/software and firmware computer system requirements of organizations with constrained resources;
5. Using modern computer engineering models, tools, and information technologies to develop computer hardware;
6. Undertaking research, and laboratory and real-life and real-time experiments by using computers and computer-based devices/systems and having the ability to acquire, analyse, and interpret data and to solve engineering and other problems locally and globally;
7. Working on interdisciplinary and multidisciplinary concepts with teams as well as individually in developing new computer engineering knowledge, products, and services needed for the seamless functioning and wellbeing of society;
8. Appreciating and using life-long learning to improve self-employability as well as adapting to future professional and ethical responsibilities in an efficient, effective, fair, responsible and competitive manner;
9. Practicing in different roles as engineering managers, project managers, innovators, entrepreneurs, quality controllers, researchers/knowledge creators and managers in the computer engineering field; and
10. Having an understanding of contemporary as well as legal and ethical issues impinging on computer engineering solutions deployed in society.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.
- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.
- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission

requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.

- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE LISTING

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
FRE 114	Elementary French I	1	*E	15	-
GER 115	Elementary German I	1	*E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CPE 121	Introduction to Computer Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	-
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	-
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	-

IGB 121	Readings and Practice in Igbo	1	C	15	-
FRE 124	Elementary French II	1	*E	15	-
GER 125	Elementary German II	1	*E	15	-
	Total	**20**		**240**	**180**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	45
GET 215	Students Workshop Practice	2	C	15	-
GET 216	Fundamentals of Thermodynamics	3	C	30	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**240**	**135**
200 LEVEL – SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CPE 221	Assembly Language Programming	2	C	30	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory 11	1	C	-	45
GET 229	SIWES 1	3	C	-	135
	Total	**19**		**240**	**135**

*** All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CPE 311	Operating Systems I	2	C	15	45
CPE 312	Computer Engineering Laboratory Practical. I	1	C	-	45
CPE 313	Computer Organization And Architecture	2	C	30	-
GET 311	Engineering Statistics And Data Analytics	3	C	45	-
GET 312	Introduction To Artificial Intelligence, Machine Learning And Convergent Technologies	3	C	45	
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	45	-
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
	Total	**19**		**270**	**135**
300 LEVEL-SECOND SEMESTER					
CPE 321	Measurement and Instrumentation Engineering	3	C	30	45
CPE 322	Operating Systems II	2	C	15	45
EEE 322	Digital Electronic Circuits	2	C	30	-
EEE 324	Analogue Electronic Circuits	2	C	15	45
GET 322	Engineering Communication, Technical Writing and Presentation	3	C	45	
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technologies	3	C	30	45
GET 329	SIWES II	4	C	-	180
	Total	**20**		**210**	**180**

400 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CPE 411	Control Systems	2	C	30	-
CPE 412	Fundamentals of Software Engineering	2	C	30	-
CPE 413	Digital Computer Communication Networks	3	C	30	45
CPE 414	Data Mining and Data Warehousing	2	C	30	-
CPE 415	Algorithm and Data Structure	2	C	30	-
CPE 416	Microprocessors and Embedded Systems	3	C	30	45
CPE 417	Hardware Design Techniques and Verification	2	E	30	-
CPE 418	Computer Installation and Maintenance	2	C	15	45
	Total	**18**		**225**	**135**
400 LEVEL-SECOND SEMESTER					
CPE 421	Computer Engineering Laboratory Practical 11	1	C		45
CPE 422	Research Methods	2	E	30	
*GET 229	SIWES I	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
GET 421	Engineering Project 1	2	C		90
GET 422	Engineering Valuation and Costing	2	C	30	
	Total	**18**		**60**	**630**

***All Credited in the 2nd semester of 400-level**

500 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
CPE 511	Testing, Reliability and Maintainability	2	C	30	-
CPE 512	Machine Learning and Applications	3	C	45	-
CPE 513	Computer Modeling and Simulation	1	C	15	-
CPE 514	Computer Network Security	2	C	30	-
CPE 515	Digital System Design with VHDL	2	C	30	-
CPE 516	Microcontroller-Based Real-Time Control Systems	3	C	45	-
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
**CPE599	B.Eng. Project	6	C	-	270
	Total	**18**		**270**	
	500 LEVEL-SECOND SEMESTER				
CPE 521	Digital Signal Processing	3	C	45	-
CPE 522	Professional Practice And Ethics	2	C	30	-
CPE 523	Artificial Neural Network	2	E	30	-
CPE 524	Embedded Systems Design And Programming	2	E	30	-
CPE 525	Cyberpreneurship And Cyber Law	2	E	30	-
CPE 526	Robotics & Automation Engineering	2	E	30	-
CPE 527	Computer Graphics & Animation	2	E	30	-
GET 521	Engineering Management	3	C	45	-
CPE 599	Final Year Project	6	C		270
	Total	**18**		**180**	**270**

***FINAL YEAR STUDENTS MUST TAKE MINIMUM OF TWO (2) ELECTIVES IN SECOND SEMESTER.**

1. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Units C: LH 30)
Atoms, molecules, elements and compounds, and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence forces; 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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
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, 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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

STA 112: Probability I (3 Units C: LH 45)
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

GST 111: Communication in English (2 Units C: LH 15; PH 45)
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, generalization and explanations). Ethical considerations, copyright rules and infringements. Writing activities (pre-writing (brainstorming and outlining), writing (paragraphing, punctuation and expression), post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making). etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

LIB 116: Use of Library (1 Unit C: LH 15)
Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture,

Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research.

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism).

INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit E: LH 15)

Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

CPE 121: Introduction to Computer Engineering (2 Units C: LH 30)

Historical development of modern computing and computer engineering profession; roles and responsibilities of the computer engineer; career paths and development (public and private sectors, academic/research and industry); overview of computer engineering design; computer devices/hardware in the age of‘ smartness’ and Internet of Things and People ‘IoTs and P’; identification of computer software and hardware components and operational relationships (central processing units, input/output devices, operating systems, languages

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)

Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design Thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)

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. Visualization 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.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium, and Vector Analysis. Newton‘s Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm‘s Law and Series/Parallel Circuits. Kirchhoff‘s Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli‘s Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule)

MTH 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)
(Pre-requisite –MTH 112) Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two- dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)

Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit *E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30, PH 45)
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 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45, PH 45)

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

GET 215: Students Workshop Practice (2 Units C: LH 15)

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 216: Fundamentals of Thermodynamics (3 Units C: LH 30)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)

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.

CPE 221: Assembly Language Programming Learning (2 Units C: LH 30)

Language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, program control, machine control, input/output , etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C. Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Introduction to computers and computing; computer organization – 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 222: Engineering Materials (3 Units C: LH 45)

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 aluminum (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 crystallization, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterization, 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 223: Engineering Mathematics II (3 Units C: LH 45)
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 224: Strength of Materials (3 Units C: LH 45)
Consideration of equilibrium; composite members, stress-strain relation. Generalized 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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method.

Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centers in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

CPE 311: Operating Systems I (2 Units C: LH 15, PH 45)
Overview of O/S: Role & Purpose, Functionality Mechanisms to Support Client- server models, hand-held devices, Design Issues influences of Security, networking, multimedia, Windows. O/S Principles: Structuring methods, Abstraction, processes of resources, Concept of APIS Device organization interrupts. Study Unit

MODULE 1: BASIC CONCEPTS IN OPERATING SYSTEMS

Unit 1: Operating Systems Functions and Services

Unit 2: Process Concepts

Unit 3: Process Creation

MODULE 2: SCHEDULING, THREADS AND SYNCHRONIZATION

Unit 1: Dispatching

Unit 2: Threads Unit 3: Synchronization

CPE 312: Computer Engineering Laboratory Practical I (1 Units C: PH 45)
This is essentially the practical implementation of the contents of CPE311 with students working independently and in focus groups.

CPE 313: Computer Organization and Architecture (2 Units C: LH 30)
Computer fundamentals: development history of computer hardware and software; hard-wired vs stored program concept; Von-Neuman architecture; Harvard architecture: the principle of operation, advantages, and disadvantages; single address machine; contemporary computers; computer system: block diagram, functions, examples, dataflow and control line; computer arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point

representation (IEEE), floating-point arithmetic, arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits and demerits; storage and input/output systems: computer function (fetch and execute cycles), interrupts, interconnection structures (bus structure and bus types); overview of memory system, memory chip organisation and error correction, cache memory, and memory storage devices; overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor; control unit: micro-operations, control of the CPU, hard-wired implementation, control unit operation, micro-instruction sequencing and execution, and micro-programmed control; using INTEL family, and MOTOROLA family as case study of a CISC computer system; instruction set and register: machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organisation, and instruction pipelining; high performance computer systems: techniques to achieve high performance, pipelining, storage hierarchy, and units with function dedicated for I/O; RISC, introduction to superscalar processor, and parallel processor; using popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating system: Overview of operating systems, dimension and type of operating system, high-level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory, UNIX/LINUX operating system: architecture, commands, programming; window-based operating systems (MS windows)

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)

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

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

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

GET 313: Engineering Mathematics III (3 Units C: LH 45)

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical, and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals,

Line Integrals, and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. The flux of Vectors. The curl of a vector field, Gauss, Greens, and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 314: Engineering Laboratory III (1 Unit C: PH 45)

Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators, and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

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

The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales:

Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

CPE 321: Measurement and Instrumentation Engineering (2 Units C: LH 30)

Transducers and applications; general instrumentation, basic meters in DC measurement, basic meters in AC measurements, rectifier, voltmeter, electro-dynamometer, and wattmeter, instrument transformers, DC and AC bridges and their applications general form of AC bridge, universal impedance bridge, electronic instruments for the measurement of voltage current resistance and other circuit parameters, electronic voltmeters, AC voltmeters using rectifiers, electronic multi meter, digital voltmeters; oscilloscope, vertical deflection system horizontal deflection system, probes, sampling CRO; and electronic function. generators.

CPE 322: Operating Systems II (2 Units C: LH 15 PH 45)

OS purposes: resource management and the extended virtual computer; historical development. Processes: critical sections and mutual exclusion, semaphores, monitors, classical problems, deadlock; process scheduling. Input and Output: hardware and software control. Memory management: multi-programming; swapping; virtual memory, paging and symbolic segmentation; File System: operations, implementation, and performance. Operating System Security and Protection mechanisms: protection domains, access lists, capability systems, principle of minimum privilege, security threats and attacks, encryption, and authentication

MODULE 1: COMMUNICATION, DEADLOCKS AND INTERRUPTS

Unit 1: Messages

Unit 2: Deadlocks

Unit 3: Interrupts

MODULE 2: DEGUGGING AND MEMORY MANAGEMENT

Unit 1: OS Debugging Strategies

Unit 2: Memory Allocation Techniques

Unit 3: Virtual Memory

MODULE 3: DEVICE AND FILE MANAGEMENT

Unit 1: Input/Output Device Management

Unit 2: File Concepts

Unit 3: Protection Each unit consists of one or two weeks.

EEE 322: Digital Electronic Circuits (2 Units C: LH 30)
Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean algebra. Simplification of Logic expressions using Karnaugh Method. Design of combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counter. Registers and timers. Switching and wave shaping circuits. Generation of non-sinusoidal signal (multi-vibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc). Sequential circuits. Introduction to microprocessors.

EEE 324: Analogue Electronic Circuits (3 Units C: LH 30; PH 45)
Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi storage amplifiers using BJTs and FETs.

GET 322: Technical Writing and Communication (3 Units C: LH 45)
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A, B, C, D, E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organization of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports (competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organization, use of visual aids and practicing of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 323: Engineering Mathematics IV (3 Units C: LH 45)
Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturm-Liouville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

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

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

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

1. design of machine components;
2. product design and innovation;
3. part modelling and drafting in Solid works; and
4. technical report writing.

CPE 411: Control Systems (2 Units C: LH 30)

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwitz criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nichol's chart, compensation techniques; introduction to non-linear systems. (eg) D.C motor speed control, inverted pendulum) to validate theoretical predicition.

CPE 412: **Fundamentals of Software Engineering (2 Units C: LH 30)**
Introduction to software engineering fundamentals; object-oriented programming; number representations; data structure and algorithms, Abstraction, modules, and objects; designing for efficiency; object-oriented software design and implementation.

CPE 413: Digital Computer Communication Networks (2 Units C: LH 15 PH 45)
Introduction: network edge, end systems, access networks, links, network core, packet switching, circuit switching, network structure, delay, loss, throughput in networks, protocol layers, service models, Application Layer, Web and HTTP, Electronic mail, Domain Name System, video streaming and content distribution networks, Socket programming with UDP and TCP*, Transport Layer, multiplexing and DE multiplexing, connectionless transport: UDP, principles of reliable data transfer, connection-oriented transport: TCP, principles of congestion control, TCP congestion control, Network layer: The Data Plane, control plane, Router architecture, IP: Internet Protocol, Generalized Forward and SDN, Network Layer: The Control Plane, routing protocols, intra-AS routing in the Internet: OSPF, routing among the ISPs: BGP, The SDN control plane, Link Layer and LANs, error detection, correction, multiple access protocols, data center networking, Wireless Networking, Wireless links, characteristics, IEEE 802.11 wireless LANs (Wi-Fi), Network Security, Message integrity, authentication, Securing e-mail, securing TCP connections: SSL, Firewalls and IDS. Topics include layered network architectures, addressing, naming, forwarding, routing, communication reliability, the client-server model, and web and email protocols. Besides the theoretical foundations, students acquire practical experience by programming reduced versions of real Internet protocols. Practical sessions to include implementation of network topologies, configurations, and designs. Students will be able to set up a basic network with an optimized design.

CPE 414: Data Mining and Data Warehousing (2 Units C: LH 30)
This course gives an introduction to methods and theory for development of data warehouses and data analysis using data mining. Data quality and methods and techniques for preprocessing of data. Modeling and design of data warehouses. Algorithms for classification, clustering and association rule analysis. Practical use of software for data analysis. Concepts of Data Mining; Overview of Data Mining, Data Description for Data Mining, Classification of Data Mining, Data Mining Technologies. Data Mining Processes and Trends; Data Preparation and Preprocesses, Data Mining Process, Applications and trends in Data Mining. Data Warehousing Concepts; Overview of Data Warehouse, Data Warehouse Architecture, Data Warehouse Design, Data Warehouse and OLAP Technology.

CPE 415: Algorithm and Data Structure (2 Units C: LH 30)
An overview of data structure concepts, arrays, stack, queues, trees, and graphs. Discussion of various implementations of these data objects, programming styles, and run-time representations.

Course also examines algorithms for sorting, searching and some graph algorithms. Algorithm analysis and efficient code design is discussed.

CPE 416: Microprocessor and Embedded Systems (3 Units C: LH 30 PH 45)
A basic microprocessor system: the CPU, memory, I/O, and buses subsystems, basic operation of a microprocessor system: fetch and execute cycle, the architecture of some typical 8-bit, 16-bit microprocessors (INTEL, MOTOROLA) and their features; programming model in real mode: registers, memory, addressing modes; organization of the interrupt system, interrupt vectors, and external interrupts, implementation of single and multiple interrupts in real mode; programming model in protected mode: registers, memory management and address translation, descriptor and page tables, system control instructions, multitasking and memory protection, addressing modes, and interrupt system; memory interfacing and address decoding; I/O interfacing: memory mapped i/o, isolated i/o, bus timing, i/o instructions; peripheral devices interfacing: 8255 PPI/6821 PIA, 8251 USART/6821 UART, DMA, Timer/Counter chips, etc; instruction set; assembly language Programming of INTEL and MOTOROLA microprocessors; and discussion of a typical system e.g. IBM PC, Apple Macintosh.

CPE 417: Hardware Design Techniques and Verification (2 Units C: LH 30)
Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes; micro-processors, system architecture, bus control, instruction execution and addressing modes; machine codes, assembly language and high-level language programming, micro-processors as state machines; microprocessor interfacing: input/output; technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters; system development tools: simulators, EPROM programming, assemblers and loaders, overview of available microprocessor application.

CPE 418: Computer Installation and Maintenance (2 Units C: PH 90)
Topics to be covered include introduction to computer systems Fundamentals, Installation and Configuration of System/Application Software, Computer Assembly and Disassembly, Computer system parts, Maintenance Techniques, Approaches and Tools; Diagnostic Techniques; System Defragmentation. Assembly and installation; troubleshooting and Repair of Computer Systems and Accessories; Portable Computers, etc.

CPE 421: Computer Engineering Laboratory Practical II (1 Units C: PH 45)
Introduction to 8051 launch pad and Programming Environment. Read input from switch and Automatic control/flash LED (soft-ware delay). Interrupts programming example using GPIO. Configure watchdog timer in watchdog & interval mode. Configure timer block for signal generation (with given frequency). Read Temperature of LM 35 with the help of ADC. Test various Power Down modes in 8051 microcontroller PWM Generator. Use Comparator to compare the signal threshold level. Speed Control of DC Motor. Master slave communication between MSPs using SPI.

CPE 422: Research Methods (2 Units E: LH 30)
Origins and definitions of research; problem identification and formulation; research types/design; qualitative, quantitative and mixed methods of research; measurement; sampling; data analysis; interpretation of data and technical report writing; use of encyclopedia, research guides,

handbooks, academic databases for computing and computer engineering discipline; use of tools/techniques for research production: referencing formats/styles and software; research management and reporting best practices; plagiarism-definitions, types, detection software; basics of document analysis, systematic review and management methods; practical documentation/presentation projects/seminars.

GET 421 Engineering Project I (2 Units: C; PH 90)
In the second semester of the 400-level students, preferably in groups, work from the university on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units: C; LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

CPE 511: Testing, Reliability and Maintainability (2 Units C: LH 30)
Introduction to reliability, maintainability, availability, elementary reliability theory; application to power systems and electronic components; test characteristics of electrical and electronic components; types of fault; designing for higher reliability; packaging, mounting, ventilation; protection from humidity, dust.

CPE 512: Machine Learning and Applications (3 Units C: LH 45)
Introduction to machine learning; ; introduction to R or Python for machine learning: statistics for analytics: descriptive statistics, inferential statistics, estimation and hypothesis testing, ANOVA; machine learning: unsupervised learning – clustering, supervised learning – classification, decision trees, random forest, and model performance measures.

CPE 513: Computer Modeling and Simulation (1 Units C: LH 15)

Basics of Modelling and Simulation, Random Numbers Unit, Random Number Generation, Monte Carlo Method, Statistical Distribution Functions, Common Probability Distributions. Simulation Basics: Handling Stepped and Event-based Time in Simulations, Discrete versus Continuous Modelling, Numerical Techniques, Sources and Propagation of Error, Dynamical, Finite State, and Complex Model Simulations, Graph or Network Transitions Based Simulations, Actor Based Simulations, Mesh Based Simulations, Hybrid Simulations. Converting to Parallel and Distributed Simulations, Partitioning the Data, Partitioning the Algorithms, Handling Inter-partition Dependencies. Probability and Statistics for Simulations and Analysis, Introduction to Queues and Random Noise, Random Variants Generation, Sensitivity Analysis. Simulations Results Analysis and Viewing Tools; Display Forms: Tables, Graphs, and Multidimensional Visualization, Terminals, X and MS Windows, and Web Interfaces. Validation of Model Results

CPE 514: Computer Network Security (2 Units C: LH 30)

Introduction: Overview of computer security, attacks and services, control of hardware and software usage. Intruders, Viruses and Worms: Intrusion techniques. Nontechnical attacks. Password protection and its vulnerability. Intrusion detection. Nature of viruses. Malicious programs. Types of viruses. Antivirus approaches. Worm propagation and countermeasures: access control, intrusion detection and firewalls. Disaster Recovery: Recovery requirements, policy, strategy, technical team. Execution of recovery plans. Documentation and backup system. Loss estimation. Developing Secure Computer System: External Security Measures, Issue, Security Models [Specification and Verification, Bell and LaPadulla Model, Clark-Wilson Model, Goguen-Meseguer, TCSEC], Discretionary Access Requirements, Mandatory Access Requirements, User Authentication, Access and Information Flow Control, Auditing and Intrusion Detection, Damage Control and Assessment, Microcomputer Security. Entropy, perfect secrecy, unicity distance, complexity theory, NP completeness, number theory. Cryptographic System, Public Key Systems, digital signatures. Network and Telecommunication Security: Fundamentals, Issue, Objective and Threats, Security Services, Distributed System Security, the Trusted Network Interpretation, TNI Security Services, AIS Interconnection Issues, Firewalls [Gateways, Application, Cost and Effectiveness]. Database Security: Security Requirements to Databases, Designing the Security, Methods of Protection, Security of Multilevel Database.

History of cryptographic System, Public Key Systems, Digital signature. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Method Ciphers, Knapsack Ciphers, Breakable NP-Complete and Stream Ciphers, Auto key, Endpoints of encryption, One-way ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold scheme. Video Scrambling techniques. Digital video encryption techniques: principle, IRDETO, via access, Video guard etc. Security and Legality Issues: copyrights Patents, trade secret, Ownership of Products, Computer Crimes, Ethnical Issue in Computer Security.

CPE 515: Digital System Design with VHDL (2 Units C: LH 30)

Finite state machine: definition, mealy and Moore models, state diagram, state table, transition table; sequential circuits design using flip-flops, asynchronous and synchronous circuit design; algorithm state machine; design examples and exercises; structured design: design constructs, design levels, geometry-based interchange formats, computer-aided electronic system design tools, schematic circuit capture, hardware description languages, design process (simulation,

synthesis), structural design decomposition; introduction to VHDL: VHDL language abstractions, design hierarchies, VHDL component, lexical description, VHDL source file, data types, data objects, language statements, concurrent VHDL, sequential VHDL, advanced features of VHDL (library, package and sub- programmes); structural level modelling, register-transfer level modelling, FSM with data path level modelling, algorithmic level modelling; introduction of ASIC, types of ASIC, ASIC design process, standard cell ASIC synthesis, FPGA design paradigm, FPGA synthesis, FPGA/CPLD architectures; VHDL Design: top-down design flow, verification, simulation alternatives, simulation speed, formal verification, recommendations for verification, writing RTL VHDL code for synthesis, top-down design with FPGA; VHDL synthesis, optimisation and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives; and computer-aided design of logic circuits.

CPE 516: Microcontroller-Based Real Time Control Systems (3 Units C: LH 45)

Low-level microcontroller programming, hardware aspects, interrupt-driven programming, I/O interfacing, timers and signal conversion. The main purpose of this course is to demonstrate practical application of embedded controllers for actual event-driven system design, interrupts handling, and tasks processing, Real-time control concepts; open and closed loop control, feedback sensors and feedback signal conditioning controlling position, speed and acceleration in real-time. Remote control techniques, optical isolation and touchstone techniques. Multiplexed, open loop control of several devices in real-time. Interrupt-driven real-time events and physical systems. Emphasis is on control of physical devices requiring varying degrees of real-time interactions. Typical projects, include microcomputer-based motor control (stepper motors, DC motors and AC motors), traffic light control software based real time signal, function connection system monitoring and control. Operating system environment, the linking of machine code and assembly language with high level language programs for over-coming time constraints.
Multiprocessor system; Inter-processor communication strategies, IEEE-488, general purpose interface bus (GPIS).

GET 511: Engineering Project Management (3 Units C: LH 45)

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

and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

CPE 512: Engineering Law (2 Units C: LH 30)

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

CPE 521: Digital Signal Processing (3 Units C: LH 45)

Discrete signals and Z-transform, digital fourier transform, fast fourier transform; the approximation problem in network theory; synthesis of low-pass filters; spectral transforms and their application in synthesis of high-pass and band-pass filters; digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; computer techniques in filter synthesis, realisation of filters in hardware and software; and basic image processing concepts.

CPE 522: Professional Practice and Ethics (2 Units C: LH 30)

Engineering profession: structure and specializations (Nigeria and abroad), engineering basics, development of engineering profession, ethics and computer engineering, strands in ethical thinking, organisations and their structures: limited liability companies, private and public, partnerships, sole traders, special features of limited companies, responsibilities of directors; company finance: the need for capital; investment and working capital; sources of funds; equity capital and loan capital, cash flow and its importance, costing: fixed costs and variable costs; overheads; opportunity costs; depreciation; problems of cost allocation; budgeting; assessment of capital investment; discounted cash flow analysis, with particular reference to investment in software tolls and new product development; financial accounts: balance sheets, profit and loss accounts, cash flow statements; the treatment of software in company accounts; ownership of rights in software as goodwill; anatomy of software house: the company, company structure, management of staff, producing of budget, monitoring financial performance, producing budgets, computer contracts and intellectual property rights: the nature and types of intellectual property; intellectual property law (confidentiality, copyright, trademarks, and patents) and implications for the computing, computer engineering and software industry; computer misuse and criminal law: computing and criminal activity, reform and criminal law, categories of misuse, computer fraud, unauthorized access ;data protection: data protection and privacy, the impact of the internet; sociology of data management/processing: generation, users, regulation/control and general mana.

CPE 523: Artificial Neural Network (2 Units E: LH 30)

Neuron Model and Network Architectures , Perceptron Learning Rule , Background on Linear Algebra , Supervised Hebbian Learning , Background on performance surfaces and optimization , Widrow-Hoff Learning , Back-propagation , Associative Learning, Competitive Networks.

CPE 524: Embedded Systems Design and Programming (2 Units E: LH 30)
Introduction to microcomputers and embedded systems: Processor architectures, microcontrollers used in embedded systems; CPU, memory and input output units; Interrupts; Introduction to hardware level programming of embedded systems: Programming in assembler, Programming in C, Development platforms for embedded software; Introduction to microcomputer interfaces: Digital I/O, Serial I/O, Timers, Analog- to-digital conversion, Pulse Width Modulation (PWM).

CPE 525: Cyberpreneurship and Cyber Law (2 Units E: LH 30)
Introduction: Definition of creativity, innovation, examples of creativity leading to innovation, commercialization of creative and innovative ideas. Trends in technology development. Entrepreneurship management and ownership. Characteristics of entrepreneur, starting a new business, business planning, strategic planning & management, site selection and layout. Establishing new venture, risk management. Business Plan Development: definition, need, preparation of business plan. Forecasting developments and charting an action plan. Identifying the product/service, market research and feasibility study. Financing business. Sources of debt financing. Creating the marketing plan, pricing, creative advertising and promotion. Entrepreneurship case studies: Overview and analysis of successful entrepreneurs such as Bill Gates, Michael Dell, David Filo and Jerry Yang of Yahoo, etc. Nigerian Entrepreneurship: Discussion of Nigerian business environment, and illustrated with successful Nigerian entrepreneurs. Overview of the Nigerian Legal System: Civil and criminal. Basic concepts of law. Contract Law. . Current issues: digital signatures, Intellectual property and copyright. Speech Law: Defamation, Sedition, Printing Press Act. Speech on the Internet. Advertising Code: Made in Nigeria rules and guidelines, Advertising Standards. Media and Licensing law in Nigeria: Developing an in-depth understanding of the nature and function of Nigerian media law. Public and Private licensing. Intellectual and moral rights. Music royalties, synchronization rights, performance rights. Role of music publishers. Broadcast rights, merchandising. Detailed analysis of Communications and Multimedia Act. Ethic and Etiquette: New codes of social behaviour: the right to privacy.

CPE 526: Robotics and Automation Engineering (2 Units E: LH 30)
Integrated design process of robotic systems; components of robotic systems, sensors and actuators, fundamental principal of operation for components, strengths and weaknesses, and operational characteristics. The design process; integrated iterative design, sub-systems, component selection and sizing, design considerations, state-of-the-arts and challenges. Design exercises with increasing degrees of complexity. Others are robotic design concepts: integrative design, concepts analogies between electrical and mechanical systems, appreciation of components of robotic systems, formulation of design requirements, design exercise and justifications, optimal division into sub systems component, selection and sizing prototype development, appraisal of benefit and cost evolution of robotic design and challenges. case studies.

CPE 527: Computer Graphics and Animation (2 Units E: LH 30)

Definition and Concepts of Computer Graphics; Computer Graphics and Applications, Hardware, Software and Display Devices, Graphics Data Structure, Colour Theory, Image Representation. Geometric Modelling; Basic Line drawing, Mathematics of CG, Curve and Surface Design, Ray Tracing, Texture Mapping. 3D Graphics Rendering; Geometric Transformation, Scan Conversion, Three-dimensional Viewing, 3D Transform and Animation, Hidden Surface Elimination.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

CPE 599: Final Year Project (6 Units C: PH 270)

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system, and/or product/service and oral presentation/defense before a panel of assessors one of whom must be external to the University awarding the computer engineering degree.

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
Bachelor of Engineering (B.Eng.) in Electrical and Electronic Engineering

1. OVERVIEW OF DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Electrical and Electronic engineers are involved in channeling natural resources into various end-uses such as in heating, lighting, home appliances, consumer products, computing, sensing, control and communication systems. They contribute to the development of systems and devices for power, instrumentation, measurement, communication engineering, management, manufacturing, transportation, etc. They are primarily concerned with the processes of generation, transmission, transformation, control and utilization of energy and/or information. The curriculum exposes students to the breadth of electrical and electronics engineering and allows them to pursue electives in several areas including electrical circuits, electronics, electrical power systems, communication systems, signal processing, control systems, electromagnetics, optics and optical devices and computer engineering. Hence, the students are expected to take courses in the following areas:

1. Electrical circuits and electronics provide study of basic electrical devices – energy sources, resistors, inductors, capacitors, diodes and transistors – and their interconnection in operational networks. Circuit analysis and design techniques cover both analogue and digital applications;
2. Power systems emphasize the design and applications of motors, generators, transformers, distribution systems, high-voltage devices and power electronics;
3. Control systems emphasize the design and application of circuits and systems to automatically monitor and regulate operation of devices, machines and processes. Advanced technologies using digital control, intelligent processing, neural networks and programmable logic controllers are included;
4. Communication systems and signal processing cover concepts required for the characterization and manipulation of information-bearing signals, modulation systems, wireless networks, image processing and signal detection software and hardware. These courses provide instructions in the interaction, propagation and transmission of high-frequency waves and signals through space and in conductors. Topics include grounding and shielding, antennas, microwaves and systems; and
5. Optics and optical devices provide a study of solid-state materials, electronic devices and optoelectronics. Applications are in micro-fabrication, telecommunications, computing, instrumentation, lasers and fibre optics, sensing and smart technologies.

2. PHILOSOPHY

The general philosophy of the Electrical and Electronic Engineering (EEE) programme is to produce graduates with high academic and soft skills competence, capable to adequately participate, transform and impact on the Engineering and allied industries in consonance with National and Global community values, including National Policy on Industrialization and Self-Reliance.

3. OBJECTIVES

The objectives of the programme are, among others, to:

1. Apply knowledge of Science, Technology, Engineering and Mathematics (STEM) fundamentals to the solution of Electrical and Electronics Engineering related problems;
2. Design solutions for Electrical and Electronics Engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, environmental and other ethical considerations;
3. Conduct investigations of complex problems using research-based knowledge and research methods, including design of experiments, analysis and interpretation of data and synthesis of information to provide valid conclusions;
4. Create, select and apply appropriate techniques, resources and modern Engineering and IT tools: including prediction and modeling, to complex Engineering activities, with an understanding of the limitations;
5. Function effectively both as an individual and as a team member or leader in diverse and in multi-disciplinary settings;
6. Communicate effectively on complex Engineering activities with the Engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, as well as, give and receive clear instructions;
7. Demonstrate knowledge and understanding of Engineering and Management principles and equally apply them in managing multi-disciplinary projects;
8. Nurture partnership between the institution and industry for effective programme delivery;
9. Create awareness and understanding of the moral, ethical, legal and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society; and
10. Develop entrepreneurial skills and knowledge, in addition to adequate training in human and organizational systems with the spirit of self-reliance so that they can set up their own businesses.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes.

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC)

credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.

- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.
- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.
- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	-
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian People and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
FRE 114	Elementary French I	1	E	15	-
GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 121	Introduction to Electrical and Electronics Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	-
GET 122	Engineering Graphics and Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	-
CHM 124	General Practical Chemistry II	1	C	-	45
MTH 122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY 122	General Physics II	2	C	30	-
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English II	1	C	15	-
IGB 121	Readings and Practice in Igbo	1	C	15	-
FRE 124	Elementary French II	1	E	15	-
GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

*E= Elective

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics and Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**

200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 221	Applied Electricity II	3	C	30	45
EEE 222	Electrical Engineering Materials	3	C	45	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES I	3	C	-	135
	Total	**20**		**240**	**180**

*** All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 311	Electromagnetic Fields and Waves I	2	C	30	-
EEE 312	Electric Circuit Theory I	2	C	30	-
EEE 313	Electrical Machines I	2	C	30	30
GET 311	Engineering Statistics and Data Analytics	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
	Total	**20**		**270**	**120**

300 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 321	Electrical Power System Principles	2	C	15	45
EEE 322	Digital Electronic Circuits	2	C	30	-
EEE 323	Electric Circuit Theory II	2	C	30	-
EEE 324	Analogue Electronic Circuits I	2	C	30	-
GET 321	Engineering Economics	3	C	45	-
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technology	3	C	30	45
*GET 329	SIWES II	3	C	-	180
	Total	**20**		**270**	**90**

*** All SIWES credited in the 2nd Semester of 400-Level**

400 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 411	Electromagnetic Fields and Waves II	2	C	30	-
EEE 412	Reliability and Maintainability of Electrical and Electronic Components	2	C	30	-
EEE 413	Electrical Machines II	2	C	30	-
EEE 414	Communication Principles	3	C	30	45
EEE 415	Digital Electronics Laboratory	1	C	-	45
EEE 416	Signals and Systems	2	C	30	-
EEE 417	Control Systems Engineering I	3	C	30	45
EEE 418	Measurement and Instrumentation	3	C	30	45
	Total	**18**		**210**	**180**
400 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 421	Industrial Visit and Technical Presentation	2	C		90
GET 421	Engineering Project I	2	C	-	90
GET 422	Engineering Valuation and Costing	2	C	30	-
*GET 229	SIWES I	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
	Total	**17**		**30**	**675**

*** All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL-FIRST SEMESTER (ELECTRICAL ENGINEERING OPTION)					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 510	Electrical Services Design	2	C	30	-
EEE 512	Electric Power Systems Engineering	2	C	30	-
EEE 514	High Voltage Engineering	2	C	30	-
EEE 516	Electrical Machine Design	2	C	30	-
EEE 517	Control Systems Engineering II	2	C	30	-
EEE 518	Fundamentals of Electric Vehicles	2	E	30	-
EEE 519	Modeling and Computer Simulation	3	C	45	-
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
*EEE 599	Final Year Project	6	C		270
	Total	**18**		**300**	
500 LEVEL-FIRST SEMESTER (ELECTRONIC ENGINEERING OPTION)					
EEE 510	Electrical Services Design	2	C	30	-
EEE 511	Telecommunications Engineering	2	C	30	-
EEE 513	Optical and Satellite Communication	2	C	30	-
EEE 515	Industrial Electronic Design	2	C	30	-
EEE 517	Control Systems Engineering II	2	C	30	-
EEE 518	Fundamentals of Electric Vehicles	2	E	30	-
EEE 519	Modeling and Computer Simulation	3	C	45	-
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
*EEE 599	Final Year Project	6	C		270
	Total	**18**		270	135

***EEE 599 to be credited in the 2nd Semester of 500-Level**

500 LEVEL-SECOND SEMESTER (ELECTRICAL ENGINEERING OPTION)					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
EEE 521	Electric Power System Analysis, Planning and Protection	2	C	30	-
EEE 522	Power Electronics	3	C	45	-
EEE 523	Power System Modeling and Optimization	2	C	30	-
EEE 525	Hybrid Electric Vehicles	2	E	30	-
EEE 526	Electric Motor Drives	2	C	30	-
EEE 527	Power Systems Communication and Control	2	E	30	-
TEL 528	Energy Economy	2	E	30	-
GET 521	Engineering Management	3	C	45	-
*EEE 599	Final Year Project	6	C	-	270
	Total	**18**		**180**	**270**
500 LEVEL-SECOND SEMESTER (ELECTRONIC ENGINEERING OPTION)					
EEE 520	Sensor and Artificial Neural Networks	2	C	30	-
EEE 522	Power Electronics	3	C	45	-
EEE 524	Digital Signal Processing	2	C	30	-
EEE 525	Hybrid Electric Vehicles	2	E	30	-
EEE 528	Mobile and Wireless Systems	2	E	30	-
EEE 529	Solid State Electronics	2	C	30	-
ELE 521	Embedded Systems Design and Programming	2	E	30	-
GET 521	Engineering Management	3	C	45	-
*EEE 599	Final Year Project	6	C	-	270
	Total	**18**		**180**	**270**

***EEE 599 credited in the 2nd Semester of 500-Level**

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Units C: LH 30)

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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113 and CHM 121. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

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

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

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

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, generalization and explanations). Ethical considerations, copyright rules and infringements. Writing activities: pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). Post-writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

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

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

LIB 116: Use of Library (1 Unit C: LH 15)

Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization:

Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research.

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter

quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS.

GER 115: Elementary German I (1 Unit E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

EEE 121: Introduction to Electrical and Electronics Engineering (2 Units C: LH 30)
History of Electrical Engineering. Evolution of EEE. Duties of EE Engineers. Areas of specialisation and work environment. Skill requirements (soft and hard). Qualities for EE Engineers. Careers related to EEE. Typical course modules. Job outlook/opportunities for EE Engineers. Future of EEE. Professional registration (NSE, COREN, IEEE, IET, etc.). Passive components (R, L, C, transformers): descriptive features, including values and colour codes, uses in electrical circuits. DC and AC signal parameters.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design Thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation work spaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb's law and superposition. Electric field and potential. Gauss's law. Capacitance. Electric

dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)

Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**

This practical course is a continuation of PHY 117 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.

ENG 121: Use of English (1 Unit C: LH 15)

Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)

Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)
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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)

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

human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

EEE 221: Applied Electricity II (3 Units C: LH 30; PH 45)
Basic machines – DC, synchronous alternators, transformers, equivalent circuits. Three- phase balanced circuits, PN junction diode, BJTs, FETs, thyristors, communications fundamentals, introduction of TV, Radio, Telephone systems.

EEE 222: Electrical Engineering Materials (3 Units C: LH 45)
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy bands in conductors, insulators and semiconductors: electrons in metals and electron emissions; carriers and transport phenomena in semiconductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)
Introduction to computers and computing; computer organization – 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 223: Engineering Mathematics II (3 Units C: LH 45)
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 224: Strength of Materials (3 Units C: LH 45)
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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

EEE 311: Electromagnetic Fields and Waves I (2 Units C: LH 30)
Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws. Electrostatic fields due to distribution of charge. Magnetic fields in and around current carrying conductors. Time-varying magnetic and electric fields. Conduction and displacement current. Maxwell's equations (in rectangular co-ordinates and vector-calculus notation). Derivation of Maxwell's equations, electromagnetic potential and waves. Poynting vector, boundary conditions. Wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media.

EEE 312: Electric Circuit Theory I (2 Units C: LH 30)
Passive circuit elements: R, L, C, transformers; circuit theorems: Ohm's, KVL, KCL, loop current, node potential, superposition. Network response to step, ramp and impulses. Network functions: response to exponential, sinusoidal sources. Laplace transform and transfer functions: pole-zero configuration and application in solving circuits, resonance; two-port analysis and parameters.

EEE 313: Electrical Machines I (3 Units C: LH 30; PH 30)
Electromagnetic conversion principle. Transformers: Features. Principles of operation. Equivalent circuit and Phasor diagram. Regulation, efficiency, and rating. Three phase delta/star connections. DC Machines: Classification and Principles of operation. Operating characteristics. Ratings, efficiency, and applications. Induction Machines: Three phase and single phase motors. Classifications. Theory and operation. Equivalent circuits and phasor diagrams. Operating characteristics, rating and efficiency. Synchronous Machine: Classification. Theory of operation. Equivalent circuits. Phasor diagram.

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles, etc. Probability. Binomial, poison hyper-geometric, normal distributions, etc. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of AI; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python AI libraries.

GET 313: Engineering Mathematics III (3 Units C: LH 45)
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 314: Engineering Laboratory III (1 Unit C: PH 45)
Introduction to IoT, AI and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised

Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

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

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

EEE 321: Electrical Power System Principles (2 Units C: LH 30; PH 30)
Types of power station, operation, auxiliaries, economics of operation-stations, substations power supply economics, tariffs, Power factor correction. Calculation of inductances of single-phase and three-phase lines. GMR and GMD. Bundled conductors. Calculation of capacitance of single-phase and three-phase lines. Current and voltage relations: Short, medium and long lines. Network equations and calculations: Power system components and equipment: Transformers. Polyphase theory. DC, AC power distribution, network calculations. Overhead line conductors. Corona effect, voltage control, circuit breakers, load forecast, sitting of generating plants.

EEE 322: Digital Electronic Circuits (2 Units C: LH 30)
Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean algebra. Simplification of Logic expressions using Karnaugh Method. Design of combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counter. Registers and timers. Switching and wave shaping circuits. Generation of non-sinusoidal signal (multivibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc). Sequential circuits. Introduction to microprocessors.

EEE 323: Electric Circuit Theory II (2 Units C: LH 30)
Non-linear circuit analysis. Network functions, Locus diagrams. Circuit synthesis: reliability criteria, Foster and Cauer syntheses of RC, RL, LC and RLC circuits. Filters: design, operation, low, high, bandpass. Butterworth and Chebychev filter design. Active network analysis and synthesis.

EEE 324: Analogue Electronic Circuits I (2 Units C: LH 30)
Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi-stage amplifiers using BJTs and FETs.

GET 321: Engineering Economics (3 Units C: LH 45)
The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity. Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost. Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Accounting Concepts-Double Entry System, Journal, Ledger, Trail balance, Final Accounts Book Keeping System, Depreciation-Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)

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

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

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

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

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

a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

EEE 411: Electromagnetic Fields and Waves II (2 Units C: LH 30)

Power Density and Energy Relations. Duality and Doppler effects. Polarization of Plane Wave. Reflection: Reflection from perfect conductors and Transmission of plane waves. Electromagnetic potential and antipotentials. Electromagnetic (EM) radiating systems: near the far fields. Waveguides, Electromagnetic interference and compatibility. Electromagnetic modeling by finite element methods.

EEE 412: Reliability and Maintainability of Electrical and Electronic Components (2 Units C: LH 30)

Introduction to: Reliability. Maintainability and Availability. Elementary reliability theory. Application to power system components. Application to electronic components. Test characteristics of electrical components. Test characteristics of electronic components. Types of faults. Designing for higher reliability. Packaging. Mounting. Ventilation. Protection from humidity and dust.

EEE 413: Electrical Machines II (2 Units C: LH 30)

Three-phase transformers: The Complete Transformer Model. Transformer tests and determination of transformer parameters. Transformer Efficiency. Separation of core losses. Parallel operation of Transformer. Auto-Transformers.

Induction motors: Speed/Torque Characteristics as an induction motor. Testing of Induction motors. Single-phase induction motors. Induction motor power flow diagram. Starting methods of Induction motor. Induction motor speed control. Synchronous motor: Synchronous machine equivalent circuit. Synchronous machine tests. Synchronous machines connected to the Grid. Power angle characteristics of a synchronous machine. Voltage Regulation. Determination of Synchronous impedance, V-Curves, Power and Torque equations of Synchronous machine. Synchronous Generator. Parallel operations. Solving Electrical machines problems with MATLAB/SIMULINK.

EEE 414: Communication Principles (3 Units C: LH 30; PH 45)

Review of probability: Basic Concepts, Conditional and total probability, distribution and density functions. Random variables: single and multiple variables, mean variance and moments. Basic concepts, definition and classification of random processes. Stationary process and independence property. Autocorrelation and correlation functions. Ergodicity and Power density spectrum. Hilbert Transforms and Noise modelling. Linear system response to random signal. Narrowband, band-limited and band-pass processes. Optimal linear systems: matched filter for white noise and coloured noise, Wiener filters, minimum mean-squared error. Optimisation by parameter selection, Poisson points and renewals. Markov processes. Applications of random signal theory in communications. Digital modulation techniques: ASK, FSK, PSK, DPSK, M-ary modulation, continuous phase FSK, MSK, QAM, DSL Schemes. Line coding, Intersymbol Interference (ISI), Nyquist wave shaping, eye pattern, adaptive equalisation. Transmission over bandpass channel. Spread spectrum communications: pseudo noise sequences, direct sequence spread spectrum, frequency hopping spread spectrum, CDMA, application examples.

EEE 415: Digital Electronics Laboratory (1 Unit C: PH 45)

Logic modules, Logic circuits, shift registers, shift counters, ring counters, single-latch and clocked flip-flops, synchronous and asynchronous counters, up-down counters, codes and code converters, state machines.

EEE 416: Signals and Systems (2 Units C: LH 30)

System modeling. Analog signals. Convolution and correlation. Fourier and Laplace Transforms. Random processes. Sampled signals and systems. Discrete Fourier transforms. Z transforms. Analog and Digital filters. Control strategies. Open-loop, feed forward and feedback control systems. Stability, performance and sensitivity analyses. Lag Engineering and Technology. Lead compensation, Frequency domain design, PID controllers. Elements of nonlinear control.

EEE 417: Control Systems Engineering I (3 Units C: LH 30; PH 45)

Review of mathematical tools-Laplace Transform. Basic concepts and examples of control systems. Classification of control Systems. General Transfer Function for control systems. Stability Criteria by the Routh method. Systems description. First order Systems. Second order systems. Frequency and Time domains analysis of Control systems. Bode plots and Nyquist

Stability criteria. Error constants. Compensation techniques: P, PI, PD and PID. Introduction to non-linear control systems. Linearization of non-linear systems. Concept of controllability and observability. Modern control observers. Application of Matlab/Simulink, Python software in Control Systems Engineering.

EEE 418: Measurement and Instrumentation (3 Units C: LH 30; PH 45)
General Instrumentation. Basic meter in DC measurements. Basic meter in AC measurements. Rectifiers, Voltmeters, Electro-dynamometer and Wattmeter. Instrument transformers, DC and AC Bridges. Universal Impedance Bridge. Electronic Instruments for the measurement of voltage, current resistance and other circuit parameters. Electronic Voltmeters, AC voltmeters and Multimeters. Oscilloscopes. Vertical and horizontal deflection systems. Probes. Sampling CRO. Instruments for generating and analyzing waveforms; Square wave analyzers, electronic counters and their applications. Time base circuitry. Analog and Digital data acquisition system. Tape recorders. D/A and A/D conversions.

EEE 421: Industrial Visit and Technical Presentation (2 Units C: PH 90)
This course is designed to allow discussion of research and industrial related projects by both staff and students and industrial visitations. By so doing, the students are exposed to the techniques of how to present scientific ideas and technical reporting. At the end of the course, students are expected to present their technical reports in both oral and written form.

GET 421: Engineering Project I (2 Units C: PH 90)
In the second semester of the 400-level students, preferably in groups, work from the University on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units C: LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc., for a period of 6 months under the guidance of appropriate personnel in the establishment but supervised by an Academic Staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment. Also, there will be a comprehensive report covering the whole of the student's

industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

EEE 510: Electrical Services Design (2 Units C: LH 30)
Lightning installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables. Protection of low voltage installation and characteristics of low voltage equipment. Earthing and testing of electrical installation. Illumination. Polar curves. Lumen method. Aim of energy Audit. Energy Flow diagram. Energy Audit of Electrical System. Energy Audit of Heating, Ventilation and Air Conditioning Systems. Strategy of Energy Audit. Instruments for Energy Audit.

EEE 511: Telecommunications Engineering (2 Units C: LH 30)
Engineering and Technology. New Telecommunication standards, monitoring and regulation: International Telecommunications Union (history, structure and functions). Global telecommunications standards collaboration: international and regional. Nigerian Communications Act. Nigerian Communications Commission. Spectrum Management: basics of spectrum management: RF spectrum, classifications and features, spectrum utilization, need for spectrum management, spectrum management goals. Spectrum management functions. Spectrum policy, planning and assignment: frequency assignment and allocation procedures, national, regional and international spectrum management regulatory frameworks. Spectrum management applications (e.g. aeronautics, radio astronomy, radar, broadcasting, satellite networks, etc.). Spectrum management responsibilities: spectrum management improvement techniques, ITU's radio regulation and recommendations, ITU-R activities and study groups, CEPT, ETSI, NTIA, Ofcom, Nigerian Communications Commission (NCC), spectrum management in selected developing countries.

EEE 512: Electric Power Systems Engineering (2 Units C: LH 30)
Basic Concepts: Review of basic concepts of three-phase power and reactive power flow. Single line and reactance diagram of power systems. Per-unit representation. An overview of power system. Load Flow Analysis: Representation of power system. Bus admittance matrix. Power flow equations. Power-flow solutions by Gauss-Seidel and Newton-Raphson methods, Sparcity Techniques, Decoupled and fast decoupled methods. Symmetrical and Unsymmetrical Faults: Transients in series R-L circuit. Internal voltages of loaded machines under fault conditions. Symmetrical fault, Z-bus and fault analysis using Z-bus. Symmetrical components, Sequence networks. Unsymmetrical faults: single line-to-ground fault, line-to-line fault and double line-to-ground fault. Stability studies.

EEE 513: Optical and Satellite Communication (2 Units C: LH 30)
Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, coupling. Deep space communication system/capacity, reliability economy/application of Pulse-code Modulation (PCM) and a Differential Pulse-code modulation (DPCM) concepts. Orbital equations for satellites in space. Kepler’s laws of planetary motion. Space segment-based satellite subsystems including: Altitude and Orbit Control System (AOCS). Telemetry. Tracking. Command (TTC) system. Power Subsystem, Communication Subsystem and Antenna Subsystem. System noise temperature. Gain to noise (G/T) ratio, Downlink design, Uplink design and design for specified carrier-to-noise ratio (C/N). Design examples. Analogue and Digital modulation

techniques employed in satellite communications including: Frequency Modulation (FM) transmission by satellite and Single Channel Per Carrier (SCPC) FM links. Digital transmission and Modulation/Demodulation and Digital transmission of analogue signals. Various multiple access schemes relevant to satellite communications: Frequency Division Multiple Access (FDMA), Time Division MA, Code Division MA, Spread Spectrum Transmission and Reception. Very Small Aperture Terminal (VSAT) systems. Their network architectures, Access control protocols, Basic techniques and VSAT Earth Station engineering.

EEE 514: High Voltage Engineering (2 Units C: LH 30)

Generation and measurement of high voltages. Generation and measurement of high currents. Voltage multipliers. Van-de-Graff generators. Impulse voltages and currents. Breakdown theories of: gaseous dielectrics, Liquid dielectrics and Solid dielectrics. Lightning phenomena. High voltage equipment. Insulation co-ordination. Lighting protection. Electric cables and condenser. Measurement of D.C. resistivity. Dielectric constant and loss factor. Testing of insulators and bushings. Testing of cables, circuit breakers, transformers and surge diverters.

EEE 515: Industrial Electronic Design (2 Units C: LH 30)

Solid-state devices and circuits. Programmable controllers. Thyristors. Lasers. Fiber optics. Power supplies. Op-amp circuits. Open-loop (feedback) systems. Closed-loop feedback systems. Input devices. Output devices. AC Motors. DC motors. Motor control devices. Robots. Other motion control systems. Data communications.

EEE 516: Electrical Machine Design (2 Units C: LH 30)

Electric machine construction. Cables and magnetic cores. Insulating materials and their specification. Cooling. Heating and temperature rise data/curve. Ventilation/cooling curves. Winding arrangements. Flux flow and distribution in the cores for different windings. Flux wave approximations. Flux wave calculations. Basic principles of electric machine design using machine output and dimensions: Design of inductors. Design of transformers. Design of dc machines. Design of induction motor. Design of synchronous machines. Determination of machine core shapes and dimension, winding cable current rating, insulation and cooling specifications for given output rating. Computer applications to design of electrical machines, using simulation software.

EEE 517: Control Systems Engineering II (2 Units C: LH 30)

State-space analysis: Linear systems with multiple eigenvalues, Nonlinear state-space representation. Linearization and Jacobian matrices, Decomposition of system into controllable and uncontrollable parts, Deadbeat response-pole assignment with state and with output feedback, Introduction to advanced control topics: optimal control. Adaptive control systems. System identification of dynamic systems, least squares, Process Control: Introduction to Process Control, PID, PID Controller Tuning, PID Controller Implementation Programmable Logic Control: The Software Environment and Programming of PLC.

EEE 518: Fundamentals of Electric Vehicles (2 Units E: LH 30)

A brief history of Electric Vehicles. Electric Vehicle Technology – layouts, cables, components, Controls. Performance of Electric Vehicles. Traction Motor Characteristics. Tractive effort and Transmission Requirements. Vehicle resistance. Types: Rolling resistance, grading resistance. Aerodynamic drag vehicle performance. Calculation of the rolling resistance and the grade resistance. Calculating the acceleration force. Maximum speed. Finding the total Tractive effort.

Torque required on the drive wheel. Transmission: Differential, Clutch and Gear box, Braking performance. Electric Vehicle chassis and body design. Batteries – overview and its types. Battery plug-in and Ultra-capacitor. Charging – Methods and Standards. Vehicle motion and the dynamic equations for the vehicle. Regenerative Braking, Economy, Vibration and Noise reduction. Types and classification of EV. Advantages of EV over fossil-fuel vehicles. Limitations of EV. Impact on environment of EV technology. Disposal of battery, cell and hazardous material and their impact on environment.

EEE 519: Modeling and Computer Simulation (3 Units C: LH 45)

Introduction to system modelling. Model formation. System definition. Classification of models. Characteristics of models. Importance of mathematical models. Methodology. Defining and documenting the problem. Analysis of data. Formulation of subsystem models. Simulation/Software tools. Merits and Demerits of Computer software. Integration of subsystems. Running and debugging of programs. Introduction to MATLAB/SIMULINK software. Practical applications to Electrical/Electronic Engineering: Curve fitting, Interpolation, Electrical network, thermal modelling, Transient studies, Stability studies, Bus-Admittance matrix formation and Power forecasting.

GET 511: Engineering Project Management (3 Units C: LH 45)

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

GET 512: Engineering Law (2 Units C: LH 30)

Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design

for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

EEE 520: Sensor and Artificial Neural Networks (2 Units C: LH 30)

Introduction to sensors and actuators in electronics systems: sensing principles for measuring motion, force, torque, pressure, flow and temperature using analogue and digital transducers. Basics of Energy Transformation: Transducers, Sensors and Actuators. Understanding of Sensor Interfacing with Microprocessor to build electronic systems. Static and Dynamic Characteristic Parameters for Sensors and Actuators. Calibration of Sensor-based electronics systems. Sensor performance criteria and selection, including: (a) Thermocouples (b) Resistive sensors (c) Inductive sensors (d) Capacitive sensors (e) Piezoelectric sensors (f) Encoders and tachometers. Process Control: Introduction to Process Control, PID, PID Controller Tuning, PID Controller Implementation Programmable Logic Control: The Software Environment and Programming of PLC, Sequence Control and Structured RLL Programming, Programming of PLCs Sequential Function Chart. Introduction to Artificial Neural Network and applications, Fuzzy Logic.

EEE 521: Electric Power System Analysis, Planning and Protection (2 Units C: LH 30)

Principles of power systems protections: Requirements. Current and voltage level protection. Time grading. Principles of simple differential protection schemes. Deregulated Power Systems: Historical Development. Technical issues. Economic issues. Regulatory issues. Challenges in decentralized control of power systems. Optimal power flow tools applied to deregulated electric power industry. Transaction management system (TMS). Congestion management. Nigerian Power Systems and Deregulation. Modelling of power systems Components. Load growth. Load forecasting. Introduction to power systems planning and operation using mathematical programming techniques.

EEE 522: Power Electronics (3 Units C: LH 45)

The basics of three-phase circuits, connections. Voltage and current analysis. Real and reactive power calculations. The fundamentals of electricity conversion from the form supplied by the source to the forms required by the load. Power electronic conversion techniques, including the basic converters (DC-DC, AC-DC and DC-AC). Power Switching Methods. Power control methods. The methods of circuit analysis applicable to switched mode circuits. Essential properties of the relevant semiconductor devices. Simple converters for practical applications. Characteristics of power devices. DC-DC converters: AC Current, Voltage, Power. AC-DC converters. Inverters (DC-AC converters). Application of Multisim or Electronic Workbench software in Power Electronics.

EEE 523: Power System Modeling and Optimization (2 Units C: LH 30)

Power system components functions, application and performance. Relative cost. Overall planning problem considering: present worth. Cost benefit principles. System reliability. Load forecasting. Non-linear programming: constrained minimization methods. Unconstrained minimization methods. LaGrange multipliers. Kuhn – Tucker conditions. Linear Programming. Quadratic Programming. Integer Programming. Applications of optimization techniques to power system: Dispatch. Optimal load shedding. Transmission planning. Application of MATLAB/SIMULINK to power system modelling.

EEE 524: Digital Signal Processing (2 Units C: LH 30)
Review of discrete-time signals and systems with emphasis on sampling and quantization. Introduction to DSP hardware architecture: including fixed-point. Floating-point processors. The multiply-accumulate unit. The discrete Fourier transform. The fast Fourier transform (FFT). The use of the FFT for convolution analysis. The use of FFT for spectral analysis. Convolution analysis using the discrete-time Fourier transform. Spectral analysis using the discrete-time Fourier transform. Z-transforms. Pole-zero analysis of discrete-time systems. Pole-zero-based digital filter design. Analysis of FIR and IIR discrete-time systems with emphasis on phase response. Design and implementation of FIR digital filters. Design and implementation of IIR digital filters. Introduction to multi-rate signal processing and filter banks.

EEE 525: Hybrid Electric Vehicles (2 Units E: LH 30)
History of HEVs. Classification of HEVs – Micro, Mild, Full, Plug-in. HEV layout. Basic architecture of HEV drive train. State of the art of HEVs. Analysis of series drive train, parallel drive train and series-parallel Hybrid drive train. Vehicle motion and the dynamic equations for the vehicle. Propulsion systems and components of HEVs. Regenerative Braking, Economy, Vibration and Noise reduction. Types of HEV and its controls. Advantages and Disadvantages of HEVs. Comparison of HEVs with Electric Vehicles. Power Electronics in HEVs. Comparison of different Energy storage technologies for HEVs. Battery charging Control. Electric Machines and Drives in HEVs. Overview of Toyota prius.

EEE 526: Electric Motor Drives (2 Units C: LH 30)
Introduction to electric drives. Types of drives. Merits and demerits of Electric drives. Common types of motors used in electric drives. Load types. Speed/torque characteristics. Essential converter circuits, Inverter/converter-fed machines, Hybrid drive trains, traction and propulsion systems, Electric vehicles and flywheel applications, D-Q axis analysis of controlled induction motor, dynamic analysis of controlled motors. DC motor drives (Analysis and control). Synchronous motor drives. Motor drive quadrants and its operating characteristics. Motor operating quadrants and applications of motor drives. Selection of appropriate motors for electric drives. Factors of motor selection – electrical, mechanical, size, rating and cost. Motor characteristics and applications. Heating and thermal characteristics of motors. Drives for specific applications: Textile mills, steel rolling mills, cranes and hoist drives, machine tools, cement mills, etc. Application of MATLAB/SIMULINK in Electric motor drives.

EEE 527: Power Systems Communication and Control (2 Units E: LH 30)
Review of transmission line theory. High frequency communication on power lines. Carrier systems and power line carrier applications. Multiplexing, Telemetering, Signal processing and Data transmission. Control of power generation, voltage control using FACTS devices, system stability, and automatic voltage regulators, regulating transformers.

EEE 528: Mobile and Wireless Systems (2 Units E: LH 30)
Introduction and applications of Mobile and Wireless Networks. Overview of Wireless Network Topologies (Infrastructure/Infrastructure-less, Stationary/Mobile), their layered architectures, current and emerging technologies. Fundamentals of mobile and wireless network communications in the presence of a noisy channel, multiple access techniques. Wireless Radio Resource management (RRM), rate adaptation, handover, power allocation and control. Mobility models for Wireless Networks and their effects on end-to-end communication. Fundamentals of

modern Cellular Networks and their architectures. Routing protocols for Wireless Networks and solutions to obstacles induced by mobility. Performance analysis of remotely hosted communications, metric interpretation, Quality of Service (QoS) metrics and techniques based on requirements of delay sensitive wireless Internet applications. Efficient management of network resources through Power and Energy adaptation. Capacity Analysis and Evaluation, comparison of analytical models with simulations. Performance evaluation schemes for network monitoring and efficient resource management. State-of-the-art survey of the related bibliography on Wireless and Mobile systems.

EEE 529: Solid State Electronics (2 Units C: LH 30)

Finite State Machine (FSM): definition, Mealy and Moore models, state diagram, state table, transition table. Sequential circuits design using flip-flops; asynchronous and synchronous circuit design. Algorithm State Machine. Design examples and exercises. Structured design: design constructs, design levels, geometry-based interchange formats, computer-aided electronic system design tools, schematic circuit capture, hardware description languages, design process (simulation, synthesis), structural design decomposition. Introduction to VHDL: VHDL language abstractions, design hierarchies, VHDL component, lexical description, VHDL source file, data types, data objects, language statements, concurrent VHDL, sequential VHDL, advanced features of VHDL (library, package and subprograms). Structural level modelling, register-transfer level modelling, (FSM) with data path level modelling, algorithmic level modelling. Introduction of ASIC, types of ASIC, ASIC design process, standard cell ASIC synthesis, FPGA design paradigm, FPGA synthesis, FPGA and Complex Programmable Logic Device (CPLD) architectures. VHDL design: top-down design flow, verification, simulation alternatives, simulation speed, formal verification, recommendations for verification, writing Register Transfer Language (RTL) VHDL code for synthesis, top-down design with FPGA. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer-aided design of logic circuits.

ELE 521: Embedded Systems Design and Programming (2 Units E: LH 30)

Introduction to microcomputers and embedded systems: Processor architectures, Microcontrollers used in embedded systems; CPU, memory and input output units; Interrupts; Introduction to hardware level programming of embedded systems: Programming in assembler, Programming in C, Development platforms for embedded software; Introduction to microcomputer interfaces: Digital I/O, Serial I/O, Timers, Analog- to-digital conversion, Pulse Width Modulation (PWM).

TEL 528: Energy Economy (2 Units E: LH 30)

This course explores the theoretical and empirical perspectives on individual and industrial demand for energy, energy supply, energy markets and public policies affecting energy markets. It discusses aspects of the oil, natural gas, electricity and nuclear power sectors and examines energy tax, price regulation, deregulation, energy efficiency and policies for controlling emission.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction

and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

EEE 599: Final Year Project (6 Units C: PH 270)

Individual student or group of students' projects undertaken to deepen knowledge, strengthen practical experience and encourage creativity, entrepreneurship and independent/team work (as may be the case). The project ends in a comprehensive written report of a developed system and/or product/service and oral presentation/defense before a panel of assessors, one of whom must be external to the University awarding the Electrical and Electronic Engineering Degree.

DEPARTMENT OF FOOD ENGINEERING
Bachelor of Engineering (B.Eng.) in Food Engineering

1. OVERVIEW OF DEPARTMENT OF FOOD ENGINEERING

The Department of Food Engineering in the College of Engineering and Engineering Technology of Michael Okpara University of Agriculture Umudike, offers comprehensive undergraduate and graduate programs that span from fundamental research in food processing and preservation, food storage and packaging, human nutrition, and food product development to innovative studies in food process design, food machinery design, equipment and plant design, fabrication and maintenance, and computerized food technologies. Our programs emphasize understanding food systems performance at multiple scales for food safety assurance and nutrition enhancement, including the application of emerging and novel technologies, AI and machine learning for food processing and preservation, and human-robot interaction to solve complex food manufacturing and engineering problems. Undergraduate students in our Food Engineering program engage in cutting-edge research on food dehydration, thermal and non-thermal processing, food storability and storage stability. They seek to develop food systems that would function as medicine, generate computer algorithms that can be used to compound such food systems with great precision and accuracy, and explore the utilization of biological systems and materials for renewable energy generation. Key areas of study include food process modeling and simulation, food machinery development, food storage and transport design, food plant design and management, advanced separation and analytical techniques. Students are trained to be at home with Food Chemistry, Food Microbiology, Food Biotechnology, and Food Biochemistry. They delve into fermentation technologies, food polysaccharides, their modifications and functionality, advanced food analysis, quality inspection and evaluation using thermal imaging and spectroscopic and radiometric techniques.

Food Engineering covers a wide range of activities, including the application of transport phenomena, materials science, solid mechanics, heat and mass transfer and thermodynamics in food processing. Our research is strongly multidisciplinary, with robust connections to Applied Mathematics, Applied Physics, Food Science and Technology, Nutrition and Dietetics, Agricultural and Bioresources Engineering, Chemical Engineering, Chemistry and Microbiology. The students have the opportunity to work closely with renowned faculty on groundbreaking interdisciplinary research projects from 400level, preparing them for leadership roles in academia, industry, and beyond.

2. PHILOSOPHY

The general philosophy of the Food Engineering program is to produce graduates who are competent in the design of food processes, machinery/equipment-systems and plants, with skills anchored on sound scientific and technological foundations of thorough understanding of the causative mechanisms rather than on costly empiricism derived from trial-and-error, and who possess adequate practical background for self-employment in addition to being of immediate value to the industry, academia and the community in global food security.

3. OBJECTIVES

The objectives of the programme are to adopt and integrate the principles of Science, Technology, Engineering and Mathematics (STEM) in:

1. Producing graduates who will be involved in food product/process development, research and development, processing and preservation;
2. Training Engineers who will serve the food industry at all levels in food process design, food machine and plant design, fabrication, maintenance and evaluation of food processing machines and plants, the conversion of raw agricultural produce into processed, packaged, shelf-stable food products and intermediate raw materials; and who will establish, maintain and assure the quality of food products and processes in the plant/factory;
3. Directing the acquisition of practical experience in the food industries, food research laboratories/stations/higher academic institutions, government establishments/parastatals and international organizations for the Engineer while in training;
4. Supporting governmental agencies responsible for the formulation and enforcement of food laws and;
5. Developing and imparting entrepreneurial skills that will make graduates employable or self-reliant in job creation.
6. Understanding all the materials, components, machines, equipment, production techniques and systems in food technology by the graduates;
7. Adapting and adopting exogenous technology in order to solve local technical problems on graduation;
8. Managing people, funds, materials and equipment efficiently by graduates.
9. Improving on indigenous technology to enhance local problems-solving capabilities by graduates;
10. Developing novel products, simulating imported food products, consequently helping to decrease capital flight by graduates.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.
- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other

acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.

- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.
- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
FRE 114	Elementary French I	1	E	15	
GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
FDE 121	Introduction to Food Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	
GET 122	Engineering Graphics and Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	
IGB 121	Readings and Practice in Igbo	1	C	15	-
FRE 124	Elementary French II	1	E	15	
GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

***E = Elective**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**

200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
FDE 221	Fundamentals of Food Processing, Preservation and Packaging	2	C	30	45
FDE 222	General Biology for Engineers	1	C	15	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C	-	135
	Total	**20**		**255**	**180**

*** All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL-FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 311	Food Chemistry for Engineers	2	C	30	-
FDE 312	Food Microbiology for Engineers	2	C	30	-
FDE 313	Conversion and Ancillary Operations in Food Processing	2	C	30	-
GET 311	Engineering Statistics and Data Analytics	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
	Total	**20**		**270**	**90**

300 LEVEL-SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 321	Food Chemistry for Engineers Lab	1	C	-	45
FDE 322	Separation Operations in Food Processing	2	C	30	-
FDE 323	Principles of Food Preservation	2	C	30	-
FDE 324	Heat and Mass Transfer in Food Processing I	2	C	30	-
FDE 325	General Food Engineering Lab	1	C	-	45
GET 321	Engineering Economics	3	C	45	
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technology	3	C	30	45
*GET 329	SIWES 1I	4	C	-	180
	Total	**20**		**255**	**135**

* **All SIWES credited in the 2nd Semester of 400-Level**

400 LEVEL-FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 411	Technology of Flesh Food Products	2	C	30	-
FDE 412	Theory of Machines	2	C	30	-
FDE 413	Technology of Plant Food Products	2	C	30	-
FDE 414	Engineering Properties of Food Materials	2	C	45	-
FDE 415	Food Quality Control	2	C	15	45
FDE 416	Food Process Design	3	C	30	45
FDE 417	Machine Design	3	C	45	-
FDE 418	Food Analysis	2	C	15	45
	Total	**18**		**240**	**135**

400 LEVEL-SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 421	Laboratory Practical (Animal Products, Fruits and Vegetables)	2	C	-	90
GET 421	Engineering Project I	2	C	-	90
GET 422	Engineering Valuation and Costing	2	C	30	-
*GET 229	SIWES I	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
	Total	**17**		**30**	**675**

* **All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL-FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 511	Food Packaging and Storage Engineering	2	C	30	-
FDE 512	Food machinery and Equipment Design	2	C	15	45
FDE 513	Drying Technologies	2	C	30	-
FDE 514	Heat and Mass Transfer in Food Processing II	2	C	30	-
FDE 515	Process Control and Automation	2	C	30	-
FDE 516	Food Safety Engineering	1	C	15	-
FDE 517	Food Polysaccharides and Powder Engineering	2	E	30	-
FDE 518	Biochemistry of Food Processing	2	E	30	-
FDE 519	Engineering Measurement and Instrumentation	2	E	30	-
FDE 510	Unit Operations in Food Processing	2	E	15	45
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
**FDE 599	B.Eng. Project	6	C	-	270
	Total	**18**		**255**	**90**

NOTE: A student is required to take a minimum of one elective in the First Semester 500 level

500 LEVEL-SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
FDE 521	Food Plant Design and Economics	2	C	30	-
FDE 522	Food Biotechnology	2	C	30	-
FDE 523	Food Processing Operation Modeling and Simulation	3	C	45	-
FDE 524	Food Refrigeration and Packaging Technologies	2	E	30	-
FDE 525	Principles of Human Nutrition	2	E	30	-
FDE 526	Fermentation Technology	2	E	30	-
FDE 527	Novel Technologies in Food Processing	2	E	30	-
FDE 528	Cereal, Legume, Beverage and Sugar Technologies	2	E	30	-
FDE 529	Process Optimization	2	E	30	-
FDE 520	Dairy Technology	2	E	30	-
GET 521	Engineering Management	3	C	45	3
**FDE 599	B.Eng. Project	6	C	-	270
	Total	**18**		**180**	**270**

****FDE 599 credited in the 2nd Semester of 500-Level**

NOTE: A student is required to take a minimum of one elective in the Second Semester 500 level

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)
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.

CHM 113: General Chemistry I (2 Units C: LH 30)
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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)

This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

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

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

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

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)

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 selfreliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and

Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

LIB 116: Use of Library (1 Unit C: LH 15)

Introduction and Historical Background of Libraries: Evolution and significance of libraries. The role of libraries in education and research. The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification (LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France's history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L'agriculture (Some

verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L'heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit *E: LH 15)

Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

FDE 121: Introduction to Food Engineering (2 Units C: LH 30)

Review of various engineering disciplines leading to evolution of Food Engineering, Philosophy, definition and interrelationship of Food Science, Technology and Engineering. Interphases of agriculture, food and nutrition, as disciplines of academic study and as profession. Review of global food situation with emphasis on Nigeria and Africa. Food Process engineering, security issues in developing countries. The Nigerian food industries and Engineering. The food engineer as a problem solver: roles of Food Engineers in National Development. Description/definition of the following: Process. Food process engineering. Flow charts and descriptions of some processes. Steady and unsteady state. Batch, continuous and semi- continuous operations. Unit operations and classifications. Mathematics involved in food engineering problems. Engineering Unit and dimensions, mass and energy balances. Introduction to dimensional analysis and similarity theorem.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)

Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in

Mechatronic Design. Design thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modelling I (2 Units C: LH 15; PH 45)
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.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium, and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional coordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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 in PHY 122 and PHY 124 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.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book

Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)
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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)
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.

ENT 211: Entrepreneurship and Innovation (2 Units C: LH 30)
The concept of entrepreneurship (entrepreneurship, intrapreneurship/corporate entrepreneurship); theories, rationale and relevance of entrepreneurship (Schumpeterian and other perspectives, risk-taking, necessity and opportunity-based entrepreneurship, and creative destruction); characteristics of entrepreneurs (opportunity seeker, risk-taker, natural and nurtured, problem solver and change agent, innovator and creative thinker); entrepreneurial thinking (critical thinking, reflective thinking and creative thinking). Innovation (The concept of innovation, dimensions of innovation, change and innovation, knowledge and innovation). Enterprise formation, partnership and networking (basics of business plan, forms of business ownership, business registration and

alliance formation, and joint ventures). Contemporary entrepreneurship issues (knowledge, skills and technology, intellectual property, virtual office and networking). Entrepreneurship in Nigeria (biography of inspirational entrepreneurs, youth and women entrepreneurship, entrepreneurship support institutions, youth enterprise networks and environmental and cultural barriers to entrepreneurship). Basic principles of e-commerce.

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)
Scope of philosophy; notions, meanings, branches and problems of philosophy. Logic as an indispensable tool of philosophy. Elements of syllogism, symbolic logic— the first nine rules of inference. Informal fallacies, laws of thought, nature of arguments. Valid and invalid arguments, logic of form and logic of content — deduction, induction and inferences. Creative and critical thinking. Impact of philosophy on human existence. Philosophy and politics, philosophy and human conduct, philosophy and religion, philosophy and human values, philosophy and character molding, etc.

FDE 221: Fundamentals of Food Processing, Preservation and Packaging (2 Units; E; LH 30)
The chemical, physical and microbiological basis of food deterioration and spoilage. Chemical preservatives. Steaming. Baking. Roasting. Frying. Extrusion. Evaporation Refrigeration and freezing. Crystallization. Detailed description of mechanisms of operation including diagrams/sketches of different equipment involved in these preservation techniques should be emphasized. Fundamentals of food packaging. Chemical kinetics in food processing.

FDE 222: General Biology for Engineers (1 Unit; LH 15)
Cell structure and organization. functions of cellular organelles. characteristics and classification of living things. chromosomes, genes their relationships and importance. General reproduction. interrelationships of organisms (competitions, parasitism, predation, symbiosis, commensalisms, mutualism, saprophytism). Heredity and evolution (introduction to Darwinism and Lamarckism, Mendelian laws, explanation of key genetic terms). Elements of ecology and types of habitats.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)
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 222: Engineering Materials (3 Units C: LH 45)
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 223: Engineering Mathematics II (3 Units C: LH 45)

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 224: Strength of Materials (3 Units C: LH 45)

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

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 226: Electrical and Electronic Engineering Laboratory (1 Unit C: PH 45)

Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)

Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)

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

FDE 311: Food Chemistry for Engineers (2 Units; C; LH 30)

Naturally occurring constituents of foods. Their structure, chemical and physical properties and significance. Food activities. Chemical, physical and biochemical changes that occur in food during handling, processing and storage such as carbohydrates and their derivatives. Proteins in food systems, Rancidity of fats and oils etc. Food colloids, emulsions, and foam: - Food flavour and additives. Terpenoids, porphyrins. Enzymes and the use in the food industry. Toxic constituents of foods and their mode of degradation in the body.

FDE 312: Food Microbiology for Engineers (2 Units; C; LH 30)

Microorganisms and their functions in food spoilage, preservation and in food production. Classification of bacteria, fungi and yeast important in foods. Relation between structure and function of eukaryotic and prokaryotic protest. Microbial growth, microbial metabolism. Mechanism of pathogenicity. Factors that influence microbial activity on foods. Effect of microbial activity on processing equipment. Alcoholic drinks production and aromatic products. Laboratory methods of assessing microbiological status of different classes of food commodities. Beverages, Cereals. Roots and tubers. Fruit and vegetables. Meat. Fish. Dairy products. Sanitary aspects of food-borne diseases. Control of pathogens in foods. Insects and rodents in food and their control. Water microbiology. Water disinfection and its quality in the food industry.

FDE 313: Conversion and Ancillary Operations in Food Processing (2 Units; C; LH 30)
Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machineries which underpin the following operations in food industries: Conversion operations including size reduction. Mixing. Emulsification. Homogenization.
Ancillary operations including Plant sanitation and hygiene. Water and waste water treatment. Solid waste disposal. Food waste and management. Hygienic design. Material handling of liquid and solid foods in food industry. Concepts in energy utilization in food processing (steam generation, fuel utilization, electric power utilization). Energy mix in food industries. Prospects of renewable energy in food industries.

GET 311: Engineering Statistics and Data Analytics (3 Units; C; LH 45)
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles. Probability. Binomial, Poisson hyper-geometric, normal distributions. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 312: Introductory Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units; C; LH 45)
Concepts of human and artificial intelligence; artificial/computational intelligence paradigms; search, logic and learning algorithms. Machine learning and nature-inspired algorithms – examples, their variants and applications to solving engineering problems; understanding natural languages; knowledge representation, knowledge elicitation, mathematical and logic foundations of "ai".; expert systems, automated reasoning and pattern recognition; distributed systems; data and information security; intelligent web technologies; convergent technologies – definition, significance and engineering applications. Neural networks and deep learning. Introduction to python "ai" libraries.

GET 313: Engineering Mathematics III (3 Units; C; LH 45)
Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices. Theory of Linear Equations. Eigen Values and Eigen Vectors. Analytical Geometry. Coordinate Transformation. Solid Geometry. Polar, cylindrical and spherical coordinates. Elements of functions of several variables. Surface Variables. Ordinary Integrals. Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors. The gradient of scalar quantities. Flux of Vectors. The curl of a vector field, Gauss, Greens and Stoke's theorems and applications. Singular Valued Functions. Multivalued Functions. Analytical Functions. Cauchy Riemann's Equations. Singularities and Zeroes. Contour Integration including the use of Cauchy's Integral Theorems. Bilinear transformation.

GET 314: Engineering Laboratory III (1 Unit C: PH 45)
Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators, and Embedded Platforms (Arduino, ESP32,

Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.
Sterilization. Media and stain preparation. Culture technique morphological study and biochemical characteristics of selected parathion. Basic food fermentation: alcoholic, acetic, and lactic acid and indigenous fermentation sanitation measures in food processing. Assessing microbiological status of different classes of food commodities. Beverages. Cereals. Roots and tubers. Fruits and vegetables. Meat. Fish and dairy products. Water.

ENT 312: Venture Creation (2 Units C: LH 15; PH 45)
Opportunity identification (sources of business opportunities in Nigeria, environmental scanning, demand and supply gap/unmet needs/market gaps/market research, unutilised resources, social and climate conditions and technology adoption gap). New business development (business planning, market research). Entrepreneurial finance (venture capital, equity finance, micro-finance, personal savings, small business investment organizations and business plan competition). Entrepreneurial marketing and e-commerce (principles of marketing, customer acquisition & retention, B2B, C2C and B2C models of e-commerce, First Mover Advantage, E-commerce business models and successful e-commerce companies). Small business management/family business: Leadership & Management, basic book keeping, nature of family business and family business growth model. Negotiation and business communication (strategy and tactics of negotiation/bargaining, traditional and modern business communication methods). Opportunity discovery demonstrations (business idea generation presentations, business idea contest, brainstorming sessions, idea pitching). Technological solutions (The concept of market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy. Digital business and e-commerce strategies.

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR)

(dialogue,. arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

FDE 321: Food Chemistry for Engineers Laboratory (1 Unit; C; PH 45)

Qualitative and quantitative tests in foods. Preparation and standardization of reagents. Acid and bases pH determination of buffer solution. Titrations. Report writing. Methods of separation. Preparation of chromatographic columns: thin layer paper column, ion exchange. Dialysis and electrophoresis. Removal of toxic contents in foods and its determination simple enzyme reactions. Determination of Kmax and other enzymatic parameters. Food compositions/Components.

FDE 322: Separation Operations in Food Processing (2 Units; C; LH 30)

Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machineries which underpin the following separation processes: Preliminary and preparative operations including Cleaning. Sorting. Grading. Peeling. Deskinning. Cutting. Mechanical/physical separations: sedimentation. Centrifugation. Filtration. Membrane separations (ultrafiltration and reverse osmosis). Screening, Mechanical expression. Contact Equilibrium Processes: Determination of ideal stages. Gas absorption. Distillation. Stripping, Extraction/leaching.

FDE 323: Principles of Food Preservation (2 Units; C; LH 30)

Theories, principles/mechanisms of operation, calculations with necessary examples and design features of machinery which underpin the following preservation principles: Dehydration, Blanching, pasteurization, sterilization (and commercial sterilization), Review of Kinetics of chemical reaction. Microorganisms involved in canning. Thermobacteriology (meaning, history, thermal death time curve, decimal reduction time) and its applications to canning and aseptic processing. Heat penetration within cans; factors affecting heat penetration with cans; death order of microorganisms with cans. Thermal process calculations. Canning operations. Introduction to the following non-thermal novel processing techniques: High-pressure processing, pulsed electric field processing, pulse-light, ultrasound, food irradiation. Detailed description of mechanisms of operation including diagrams/sketches of different equipment involved in these thermal processes should be emphasized.

FDE 324: Heat and Mass Transfer in Food Processing I (2 Units; R; LH 30)

Heat Transfer: Heat transfer systems (types of heat exchanger). Modes of heat transfer (conductive heat transfer- steady state in different geometries and layers. convective (free and forced) and radiative heat transfer). Estimation of convective heat and overall transfer coefficient. Fouling of heat transfer surfaces. Design of heat transfer exchanger. Unsteady state transfer. Pyschrometry and its application in food processing. Ohmic and microwave heating. Mass Transfer: Diffusion process. Convective Mass transfer. Laminar and turbulent flow (over a flat plat, in a pipe, over spherical bodies). Unsteady-state mass transfer. Transient-state diffusion. Diffusion of vapour through solid films.

FDE 325: General Food Engineering Practices Laboratory (1 Unit; C; PH 45)
Laboratory investigation and report submission for selected experiments and projects in Material and energy balances including Pearson square rule, laws of conservation of mass and energy, and other relevant areas. Determination and measurement of physical properties such as length, width, density, porosity, sphericity, etc., Data generation from laboratory analysis and the development of empirical models. Thermal properties of food materials such specific heat capacity, thermal conductivity, thermal diffusivity etc. Surface properties such as angle of repose, coefficient of friction etc. Water activity determination. Water activity: prediction. Water vapor sorption isotherm determination and selection of food packages. Importance of the afore-mentioned experiments to food process design, equipment design and food packaging technology should be emphasized.

GET 321: Engineering Economics (3 Units C: LH 45)
The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity, Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost, Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Acccounting Concepts-Double Entry system, Journal, Ledger, Trail balance, Final Accounts Book Keeping system, Depreciation - Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)
A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis, structure Fog and Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organisation of reports. Technical report writing skills(steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports(competency, major steps, components and formats of research reports and publishable communication). Sources and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organisation, use of visual aids and practising of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

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

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

exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS.
A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project. Examples of projects should include the following:

a. Design of machine components;

b. Product design and innovation;

c. Part modelling and drafting in SolidWorks; and

d. Technical report writing.

FDE 411: Technology of Flesh Food Products (2 Units; C; LH 30)
Definition of flesh foods, the value of meat, poultry and fish products as food, the meat industry in Nigeria, structure of meat, composition, nutritive value and conversion of muscles to meat. Abattoir practices, post-mortem and ante-mortem inspection and distribution of frozen carcasses. Biology of sea and fresh water fish production, handling methods, assessment of fish quality, microbiology, fish preservation technology, chilling, freezing, smoking, salting, canning and irradiation. Fish protein concentrate and other fish products production.

FDE 412: Theory of Machines (2 Units; C; LH 30)
Force analysis of mechanisms, fluctuation of kinetic energy and inertial effects. Complete static and dynamic analysis. Flexible shaft couplings: belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery. Vibration of machinery; free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts and torsional vibrations.

FDE 413: Technology of Plant Food Products (2 Units; C; LH 30)
Fruits, Vegetables, Roots and Tuber technology: Structure, physiology, microbiology, quality, process technologies (canning, drying, concentration, refrigeration and freezing). Process technology of root and tubers. Fruits processing: production of Jams, jellies, marmalades from fruits; Juice extraction, refining and concentration; controlled atmosphere storage of fruits and vegetables. Fats and oils processing.

FDE 414: Engineering Properties of Foods (2 Units; C; LH 30; PH 45)
Definitions and importance of engineering (physical and frictional, mechanical and rheological, electrical and dielectric, optical and electromagnetic) properties of food materials. Physical and physicochemical properties of food. Measurement and determination of food grains dimensions. Length. Width. Thickness. Density. Porosity. Geometric dimensions. Aspect ratio. Sphericity. Surface properties. Angle of repose and angle of slide on different surfaces, static and kinetic coefficients of friction, angle of internal friction. Mechanical properties and strength of food materials. Elastic deformation. Plastic deformation. Viscous deformation. Young modulus. Shear modulus. Poisson's ratio. Evaluation of food strength. Rheology of solid foods, rheological models; Voight-Kelvin, Maxwell, Bingham etc. Food emulsions. Basic emulsion types. Emulsifying agents-hyrophilic-lyophylic balance value. Rheology of liquid foods. Newtonian and non-Newtonian fluids. Viscosity. Viscometry, Viscoelasticity. Determination of thermo-physical properties of foods. Density. Specific heat. Thermal conductivity. Thermal diffusivity. Their

determination methods. Definition and determination of water activity. The importance of water activity in foods. Water sorption isotherms. Phase transition phenomena in foods. Glass transition in foods. Properties of granular materials and powders. Particle size distribution. Particle flow.

FDE 415: Food Quality Control (2 Units; C; LH 15; PH 45)

Definition. Scope and significance of food quality and quality control. Quality parameters, quality assurance and specifications. Total quality management. Food laws. Food legislation and the Codex Alimentarius. Food regulations. Food standards (International food standard and Nigerian Industrial Standards (NIS)). Good manufacturing practice (GMP). Enforcement of food standards. Principles and methods of food quality control. Quality control charts. Hazard Analysis- Critical Control, Points (HACCP) system. Plant sanitation as a quality control tool. Sensory and instrumental methods of evaluating quality parameters. Food fortification and enrichment. Nutritional labeling. Risk/benefit analysis.

FDE 416: Food Process Design (3 Units; C; LH 30; PH 45)

Product Development leading to design specification, problem identification and definition. The process design team. Survey and market analysis. The design data book. The use of design handbook and codes. Block diagram, symbolic representations of food equipment. Development of a Process Flow Diagram, material and energy balances in process calculations. Flow-sheeting. Pictorial representation of basic food equipment. Food process control and automation. Elements of Computer-Aided Process Design. Process engineering flow diagram and process charts in food processing, related symbols and conventions. Mass and energy balances, contrasting food process design from chemical process design. Conception, inventorization and associated calculations for typically complex food processing systems, process instrumentation and optimization. Optimization by differentiation, programming methods. flow-sheeting software. software. applications and examples (optimization studies for different food processes). Optimization procedures: search methods, response surface method, neural network, genetic algorithms, etc. modeling, computer simulation. Fundamentals of computer simulation: Model formulation, simulation, amongst others. Report writing and presentation.

FDE 417: Machine Design (3 Units; C; LH 45)

Journal bearings. Application of Hertz stress theory. Fluid couplings. Lubrication mechanics: hydrodynamic theory applied to tapered wedge and journal bearings and hydrostatic lubrication applied to journal bearings. Gears and power transmission systems. Elements of fluid power system design. Design of cylinders, pipes and pipe joints, tubes, plates and flywheel. Seals, packaging, gaskets and shields. Failure analysis; various types of joints, design of machine elements; system design, design of gear systems; material selection in design; design; design and production matching; optimization in design.

FDE 418: Food Analysis (2 Units; C; LH 15; PH 45)

The principles and application of analytical methods in food analysis. such as photometry, colorimetry, gravimetry, refractometry, Spectroscopy – Introduction (spectroscopy and spectrometry, Electromagnetic radiation, Electromagnetic spectrum, analyte spectrum, uses of spectroscopy). Atomic Spectroscopy, Molecular Spectroscopy, Fluorescence Spectroscopy. Polarimetry. Refractometry. Gravimetry. Electrophoresis. Centrifugation. Chromatography (Introduction, basic equipment and uses). Types of Chromatography – adsorption chromatography (liquid adsorption chromatography, liquid-liquid chromatography, Gas-liquid chromatography,

Gas adsorption chromatography and Capillary gas chromatography, Reverse phase chromatography, High performance liquid chromatography). Partition Chromatography. Ion exchange (Cation and anion) chromatography. Molecular exclusion chromatography. X ray diffraction analysis. Bomb calorimetry. NMR. Physical and chemical analysis of water and other major food components. Food colours, additives, trace metals, contaminants.

FDE 421: Laboratory Practical (Animal, Fruits and Vegetable Products) (2 Unit; C; PH 90)
Preparation and quality evaluation of smoked fish, smoked meat, cured meat, meat sausages, salted fish, salted and dried fish, solar dried fish, etc. Processing of milk into dairy products, e.g. ice cream, yoghurt, cheese, butter, etc. Evaluation of shell egg quality including external appearance (size, shape, shell colour, shell texture, shell cleanliness), Candling appearance, (air cell characteristics, shell characteristics, internal quality characteristics) and opened egg quality (Haugh unit, yolk index, percentage of thick and thin albumen, etc.). Shell egg pasteurization. Processing of egg products including powdered egg products (whole egg, egg yolk, egg white), frozen liquid egg products (whole egg, egg yolk, egg white). Mayonnaise and salad cream production. Quality tests in milk and milk products. Milk products manufacture (market milk, ice cream, yoghurt and other fermented milk products, powdered milk products (full fat milk, non-fat milk.), butter, cheese, etc. Preparation and processing of fruit and vegetable products (fruit juices, squashes, fruit bar, jams, jellies, tomato ketchup, tomato puree, dried vegetables). Preparation of canned and bottled fruits and vegetables spiced and fermented vegetables.

GET 421: Engineering Project I (2 Units C: PH 90)
In the second semester of the 400-level students, preferably in groups, work from the
University on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on themproject as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units C: LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc., for a period of 6 months under the guidance of appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's

industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

FDE 511: Food Packaging and Storage Engineering (3 Unit; C; LH 30; PH 45).
Post-harvest physiology of horticultural commodities. Tropical environment in relation to maturity, ripeness and senescence including climacteric. Physical and chemical indices and quality in fruit and vegetable crops. Control of post-harvest losses. Types and design of cold storage. Controlled atmosphere storage (CAS). Methods and equipment for low temperature preservation. Requirements and design of cold storage. Insulation and air circulation in cold storage. Refrigerants. Storage systems for fruits and vegetables. Meat and poultry products. Milk products. Handling and storage of cereal grains and legumes. Introduction and importance of food packaging. Functions and selection of packaging. Mass transfer aspects influencing effectiveness of packaging materials. Properties and techniques for packing geometries of different packaging materials. Primary and secondary containers. Degree of rigidity. Preformed and in-line forming of packages. Hermetic closure. Selection of packaging materials through sorption isotherms. Determination of shelf-life of packaged foods. Principle of operation and design of closing and sealing equipment. Can-seaming machine. Push on caps for glass containers and other sealer types. Vertical and horizontal form-fill-seal machine for sachets. Thermoforming filling and sealing system. Tetra pack aseptic packaging system. Modern packaging. Active, edible film, fiber, and Nano-composite packaging. Temperature control; self-heating and shrink-wrapping machines. Modified atmospheric packaging.

FDE 512: Food Machinery and Equipment Design (3 Units; C; LH 15; PH 45)
Review of machine design: methods and process of design, the engineering team, Unit and dimensions, engineering materials and properties, fabrication and welding processes, fit and tolerances, stresses, deflection and buckling. Food machine component, design (shaft design and critical speed analysis, coupling, key, pins, spleens, bolts, screws belts drives, gear forces, vibrations and springs, bearing and lubrication). Hygienic equipment design. Ergonomics factors in machine design. Team design project and presentation.

FDE 513: Drying Technology (2 Units; C; LH 30)
Introduction. Basic drying processes. Water activity and sorption isotherms. Review of psychrometrics application in mixing of air and drying. Moisture diffusion. Effects of food properties on dehydration. Drying-rate curves. Heat and mass transfer. Drying methods and equipment. Tray or cabinet dryers. Tunnel dryers. Puff–drying. Fluidized-bed drying. Spray drying. Drum dryers. Vacuum dryers. Freeze-drying. Dehydration system design. Mass and energy balance. Drying-time prediction.

FDE 514: Heat and Mass Transfer in Food Processing II (2 Units; C; LH 30)
Introduction: meaning and importance to process industry. Basic equations. Boundary conditions, steady one dimensional heat conduction (with and without heat generation), in various co-ordinate systems. Heat transfer from extended surfaces, insulation, lumped system analysis, exact analytical solutions of higher dimensions, steady state and transient processes. Use of charts dimensional analysis in heat transfer. Heat transfer by convection: determination of coefficient of heat transfer (dimensional analysis, cane experiments, etc). Boundary layer analysis: approximate boundary layer analysis. Correlation for heat transfer coefficient (forced and free convection). Heat transfer

with phase change; drop wise. Condensation and file condensation. Pool and flow boiling. Heat exchange by radiation: definitions. Basic laws of thermal radiation. Radiation involving black surfaces, grey surfaces and re-radiating surfaces. Thermal circuit analysis. Matrix formulation, generating view factors for elongated chemicals.

FDE 515: Process Control and Automation (2 Units; C; LH 30)

Introduction to process control and instrumentation – measuring instruments including oscilloscopes, graphics, thermocouples, sensors, accelerometers, AC and DC motors. Process requirements in the food industry. Methods of control – block diagrams, open and feedback systems, stability problems; Laplace transform, transfer function and application. Types of controllers and control actions; frequency – response analysis of elements; transient and steady state solutions; prediction of transient response, optimum control setting methods, control of processes with time delay; control system design; electrical devices and applications in food processing. Forms of signals; damping factor and critical conditions, control values and transmission lines; process dynamics e.g. control of heat exchanger, error detector and transducers, electric alarms, heat detection alarm, time relay, temperature relay, remote control, etc – applications of these control devices in food processing operations. Cascade control. Feed forward and feedback control. Introduction to multi variable control. The control valves.

FDE 516: Food Safety Engineering (1 Units; C; LH 15)

The application of engineering principles to address microbial and chemical safety challenges in food processing, including intervention technologies (traditional and novel non-thermal intervention technologies, chemical interventions, and hurdle approach); control, monitoring and identification techniques (biosensors); packaging applications in food safety (active packaging, intelligent or smart packaging); and tracking and traceability systems.

FDE 517: Food Polysaccharide and Powder Engineering (2 Units; E; LH 30)

Introduction. Sampling. Particle properties. Bulk properties. Storage. Conveying. Size reduction. Size enlargement. Starch and seed gum extraction, drying and physicochemical characterization, starch type determination using x-ray diffractometry, granule size determination, Scanning Electron Microscopy. RVA viscoamylograph. Gelatinization. Physical, chemical and biological modifications, FTIR spectroscopy, Encapsulation Processes. Mixing, Separation and classification. Drying. Undesirable phenomena and their relation to food processes.

FDE 518: Biochemistry of Food Processing (2 Units; E; LH 30)

Introduction: Introduction. Cells- Prokaryotic cells, Eukaryotic cells, Cell compartment and their characteristics Analytical techniques in food biochemistry. Water chemistry and biochemistry (hydrogen ion concentration and buffers. Properties of water: solvent nature dissociation, ionic product, Handersonhasseibech equation. Importance of buffers in biochemical systems.), Enzyme: Definition and classification of enzyme, Catalytic mechanism, chymotrypsin, Enzyme activity and kinetics, Michaelis-Menten equation, Enzymes in food. Enzymes in food processing. Protein cross-linking in food. Emphasizing on some common metabolic pathways. Embden-Meyershof. Entner-Doudoroff. Tricarboxylic-acid cycle. Homolactic fermentation. Mixed acid fermentation pathways. Biochemistry of Processing of Meat and Poultry. Seafood Processing. Milk Constituents and Processing. Fruit and fruit processing. Vegetable Processing. Fermented Foods. Dairy Products. Bakery and Cereal Products. Fermented Meat. Fermentation of Beer.

FDE 519: Engineering Measurement and Instrumentation (2 Units; E; LH 30)
General concepts and principles of instrumentation systems and components. Functional elements and configurations of instruments. Static and dynamic characteristics of instruments and data handling devices including sensing, signal conditioning, computerized data acquisition, test design, data analysis, synthesis and statistical implications of measurements. Includes laboratory. Displacement, velocity and acceleration measurement, force, torques and shaft power measurements, pressure, flow and temperature measurement, errors and measurements, error analysis in complete experiments. Standards of measurement, use of gauges. Straightness, flatness and roundness measurement, cylindrical concentricity, parallelism, taper and alignment. Measurement of surface roughness and texture. Auto Collimator, optical flat and interferometry, screw thread and gear measurements.

FDE 510: Unit Operations in Food Processing (2 Units; E; LH 13; PH 45)
Introduction to Unit Operations in Food Processing (Overview of unit operations and their significance in food processing, Mass and energy balance applications in food systems, Principles of transport phenomena: heat, mass, and momentum transfer). Size Reduction and Screening (Equipment: Crushers, grinders and cutters, particle size analysis and separation techniques, operation of hammer mills, ball mills, and sieving analysis)**.** Mechanical Separation Processes (Sedimentation, centrifugation, filtration, and membrane separation; types of filters: plate and frame, rotary vacuum, ultrafiltration; operation of centrifuges, filter presses, and membrane units). Mixing and Emulsification (Principles of solid-solid, solid-liquid, and liquid-liquid mixing, Equipment: Ribbon blenders, agitators, high-shear mixers; preparation of emulsions and suspensions using different mixers). Thermal Processing of Foods (Heat transfer mechanisms in food processing: conduction, convection, radiation; pasteurization and sterilization techniques; heat penetration studies in canned foods and HTST pasteurization). Drying and Dehydration (Theory of drying: Moisture content, drying rate, and equilibrium moisture; Types of dryers: Tray, spray, drum, and freeze dryers; drying kinetics of food materials using different drying methods). Evaporation and Distillation (Principles of evaporation and multiple-effect evaporators; vacuum evaporation and concentration of liquid foods; operation of a falling film evaporator and distillation setup). Extrusion and Forming (Principles of extrusion in food processing; Applications in cereal and snack food production; Extrusion of starch-based products using a single-screw extruder). Freezing and Refrigeration (Principles of refrigeration cycles and freezing mechanisms; Freezing rate and quality changes in frozen foods; Determination of freezing time for different food products). Food Packaging Operations (Functions of food packaging in unit operations; Influence of packaging on process efficiency and shelf-life; Vacuum packaging and MAP (Modified Atmosphere Packaging).

GET 511: Engineering Project Management (3 Units; C; LH 45)
Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organisational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness: decision making, forecasting, scheduling, work breakdown structure (WBS),

deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimisation, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organising and controlling, motivation and appraisal of results.

GET 512: Engineering Law (2 Units; C; LH 30)
Common Law: its history, definition, nature and division. Legislation, codification interpretation. Equity: definition and its main spheres. Law of contracts for Engineers: Forms of contract and criteria for selecting contractors; offer, acceptance, communication termination of contract. Terms of Contracts; suppliers' duties – Damages and other Remedies. Termination/cancellation of contract Liquidation and Penalties; exemption clauses, safety and risk. Health and Safety. Duties of employers towards their employees. Duties imposed on employees. Fire precautions act. Design for safety. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law. Business registration.

FDE 521: Food Plant Design and Economics (3 Units; C; LH 15; PH 45)
Technical feasibility study of food production. Food Plant Economics. Feasibility analysis. Food factories, types and purposes. Site Selection**:** Location, marketing utilities and facilities, soil investigation and plant layout designs in the food industry. Facility design emphasizing planning, foundation floors, walls, drains, windows, doors, piping, Lighting, ventilation, cleaning-characteristics of suitable construction materials. Optimum design of food processing plant to include well defined spaces for the following: raw materials storage, source of water supply, waste and by-products disposal, sanitation consideration of the plant, parking space for both empty goods and finished products industries and a plant design project.

FDE 522: Food Biotechnology (2 Units; C; LH 30)
Introduction. Importance. History. Microbial metabolism. Developments in metabolic and biochemical engineering. Metabolites. Range of fermentation processes. Components of fermentation processes. Isolation and preservation of industrially important microorganisms. Industrial fermentations. Media, design and types of fermenters. Process variables in fermentation. Recovery and purification of fermentation products. Production of organic acids. Enzymes, amino acids, single cell proteins, carotenoids and fermented food products. Microbial genetics. Conjugation, transduction and transformation. GMO in food biotechnology. Legal and social aspects of food biotechnology.

FDE 523: Food Processing Operation Modelling and Simulation (3 Units; C; LH 45)
Use of computational tools to solve models and implicit equations covering transfer, separation, chemical reactions and thermodynamic systems involving steady and unsteady state. Process

simulation using the HYSYS software or any other process simulation software, including ASPEN, MATLAB, Geogebra, Winplot, ESES.

FDE 524: Food Refrigeration and Packaging Technologies (2 Units; E; LH 30)
Introduction and importance of food packaging. Functions and selection of packaging. Mass transfer aspects influencing effectiveness of packaging materials. Properties and techniques for packing geometries of different packaging materials. Primary and secondary containers. Degree of rigidity. Preformed and in-line forming of packages. Hermetic closure. Selection of packaging materials through sorption isotherms. Determination of shelf-life of packaged foods. Principle of operation and design of closing and sealing equipment. Can-seaming machine. Push on caps for glass containers and other sealer types. Vertical and horizontal form-fill-seal machine for sachets. Thermoforming filling and sealing system. Tetra pack aseptic packaging system. Modern packaging. Active, edible film, fiber, and Nano-composite packaging. Temperature control; self-heating and shrink-wrapping machines. Modified atmospheric packaging. Application of thermodynamic theory and design principles to food refrigeration and cryogenics systems. Refrigeration and air conditioning, equipment design, fault diagnosis, scheduled maintenance.

FDE 525: Principles of Human Nutrition (2 Units; E; LH 30)
Protein-Caloric malnutrition. Calorie and energy requirements. Digestion and absorption metabolism of carbohydrates, protein lipids, fat. Important mineral and vitamins deficiencies. Effects of processing on nutritional requirements. Nutrients fortification and enrichment programme. Food Balance sheet, Food composition table and recommended dietary allowance. Toxicology of common food contaminants.

FDE 526: Fermentation Technology (2 Units; E; LH 30)
Introduction. Factors affecting growth of microorganisms in food cultures. Isolation, selection, preservation and improvement of industrial Microbes. Screening of industrial microbes. Strain improvement Bioreactors (Fermenters). Essential features of a bioreactor. Microbial nutrition, growth and control. Microbial growth kinetics in batch and continuous culture and biomass production. Determination of metabolite productivity. Types of food fermentations (Lactic, alcoholic and acetic acid fermentation). Types of fermenters (Bioreactors). Stirred tank bioreactor. Tower bioreactors. Air lift bioreactors. Packed - bed bioreactors. Fluidized bed bioreactors. Photo bioreactors. Design and operation of bioreactor. Types of Fermentations. Solid substrate fermentation (SSF). Submerged fermentation. Batch culture. Fed-batch culture. Continuous culture. Equipment in continuous culture. Anaerobic fermentation. Aerobic Fermentation. Optimization of Fermentation Process. Downstream Processing (DSP). Solid-Liquid Separation. Effluent treatment (Biological waste treatment). Fermented foods and beverages such as vegetables, bread, beer, milk products, yoghurt, cheese, vinegar, cocoa, soy products, some local foods and beverages. Design of fermenters. Enzyme technology: Introduction. Enzymes kinetics. Inhibition. Immobilisation. Enzyme production from microoganisms. Application of enzymes in food processing: Carbohydrases (amylases), pectic enzymes, proteases, oxidases, lipases.

FDE 527: Novel Technologies in Food Processing (2 Units; E; LH 30)
Novel technologies involving advances in food processing systems. Electrical conductivity of foods, ohmic heating, microwave heating and Infra-red heating and safety issues. Application of non-thermal technologies such as irradiation, pulsed electric field, high pressure processing, pulsed light, ultrasound, magnetic field, infrared and different imaging techniques. Membrane processing:

Ultra-filtration and reverse osmosis processing. System analysis.

FDE 528: Cereal, Legume, Beverage and Sugar Technologies (2 Units; E; LH 30)

Composition and structure of common types of cereals: Grain grades and grading. Storage methods and types. Storage variables. Dry milling process: and types of grinding machines. Principles, types of sifters. Flour treatment and quality assessment. Rheology of doughs and batters. Importance of glass transition in cereals and sugar solutions. Yeast and chemical leavened products. Quality of bread-making flour. Bread-making formulas and systems. Bread-making. Cookie making. Crackers. Cakes. Biscuits. Pastas and noodles. Breakfast cereals. Ready-to-eat cereals. Snack foods. Wet milling cereals especially maize for production of starch, sugar syrups, oil, protein. Drying milling and parboiling of rice. Processing of rice and oats. Feed and industrial uses of cereals. Rice. Rice milling system. Enrichment. Improved varieties. Rice products. Rice parboiling and its effects. Rice milling systems at village level. Commercial rice milling systems. Modern rice milling operations. Dry and wet milling of rice. Paddy separation. Rice polishers. Legumes and oil seeds. General compositions. Protein supplementation and complementation. Soybean technology. Peanuts. Milling of legumes. Physico-chemical characteristics of legumes/pulses. Unit operations in pulses processing. Milling methodologies of some legumes. Pigeon peas. Chickpeas. Black grams. Green grams.

History and development of brewing. Types of beer. Traditional brewing processes traditional beers. History and development of brewing in Nigeria. Sorghum and other cereals as brewing raw materials and adjuncts. Raw materials in beer making. Unit operations in beer brewing. Chocolate and cocoa products. Cocoa beans. Cocoa bean processing. Chocolate liquor. Cocoa butter. Chocolate. Imitation chocolate. Chocolate manufacturing practices. Tea, Leaf processing. Instant tea and Production practices of coffee. Coffee processing. Carbonated non-alcoholic beverages. History of Sugar. Sources of manufacturing sugar. Sugar production from sugar beets and sugar cane. Refining of raw cane sugar. Sugar market and consumption. Uses for sugar Ingredients and manufacture carbonated non-alcoholic beverages. Carbonated fruit beverage. Mineral water. Carbonated water. Basic chemistry of ingredients. Quality assurance and control. Spoilage and safety concerns. Wines and wine varieties. Colour. Sweetness and alcohol content. Effervescence. Fermentation and other operations. Naming of wines. Health issues involving different beverages. Health effects of different beverages.

FDE 529: Process Optimization (2 Units; E; LH 30)

Maximizing of functions through the use of calculus. Unconstrained peak seeking methods. Single and multivariables search techniques. Constrained optimization techniques. Linear programming application to chemical and food processing. Numerical optimization techniques. Discrete events.

FDE 520: Dairy Technology (2 Units; E; LH 30)

Introduction. Physicochemical properties of milk. Microorganisms of milk. Microbial spoilage of milk. Collection. Chilling and standardization of milk. Preservation of milk Refrigeration. Pasteurisation and homogenization of milk. Dehydration. Condensed milk. Evaporated milk. Uses/Defects in condensed and evaporated milk. Principles of drum and spraying drying. Comparisons of drum and sprayed dried milks. Defects and their causes in whole/skim powders. Prevention. Technologies involved in milk products. Definition, standards and classification of cheese. Milk quality in relation to cheese making. Physical and chemical treatment of milk. Cheese additives and preservatives. Role of starter culture in relation to cheese quality. Cream and butter, yoghurt. Fermented milk. Ice cream. Dairy byproducts. Principles and guidelines for the

application of HACCP system. Pesticide residues in milk. Legislation and standards. Organic milk foods. Packaging and packaging materials for milk and dairy products. Milk transport and distribution. Storage of milk. Sanitation of milk plant. Sampling for different test. Different analysis of milk. Diary Process Engineering (different types of evaporators, dryers, and fluidizers used in dairy industry). Sanitary pipes and fittings, standard glass piping, plastic tubing, fittings and gaskets, installation, care and maintenance of pipes & fittings, selection of mixing equipment in dairy industry, mixing pumps.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

FDE 599: Assigned Final Year Design and Research Project (6 Units; C; PH 270)

Student project proposal writing and presentation. Each student is expected to carry out research investigation under the supervision of a member(s) of academic staff of any area (s) of food agricultural / food engineering. The research should be directed at solving an identified problem related to food. The student is expected to make an oral presentation at a seminar of the project plan and or a literature review on the project topic before the investigation. Each student shall engage in a project done alone or in a team that will include problem identification, design process or machinery. Fabrication, implementation testing and seminar presentation.

DEPARTMENT OF MECHANICAL ENGINEERING
Bachelor of Engineering (B.Eng.) in Mechanical Engineering

1. OVERVIEW OF DEPARTMENT OF MECHANICAL ENGINEERING

Department of Mechanical Engineering, College of Engineering and Engineering Technology of Michael Okpara University of Agriculture, Umudike was established for the purpose of research and training of engineering professionals to lead in developing appropriate new technological tools (machines and techniques) and modification/optimization of existing ones for the provision of needs of material goods and services. The Department runs an undergraduate programme leading to the award of the Bachelor of Engineering (B. ENG.) Degree in Mechanical Engineering and postgraduate programmes offered by the Department include Postgraduate Diploma (PGD) in Mechanical Engineering, Master of Engineering (M. ENG.) and Doctorate (Ph. D) Degrees in Mechanical Engineering with options in Design and Production, Energy and Power, Industrial and Systems, and Materials Engineering. The programmes were structured to enhance versatile carrier opportunity of prospective graduates in all sectors such as manufacturing (automotive, chemical/process, food, petrochemical, pharmaceutical, textile .processing paper, and wood processing industries *etc*), and power generation. Others include mining (oil/gas and solid minerals), construction companies, agricultural mechanization, air conditioning and refrigeration, sanitary/sewage, defense/security, public utilities, government services, management and engineering consultancy, teaching/research, hospital and biomedical engineering sectors

2. PHILOSOPHY

The philosophy of the mechanical Engineering programme in Michael Okpara University of Agriculture, Umudike is to produce high level professionals with skills, theoretical and practical academic backgrounds to cope with a broad spectrum of challenges of self-reliance, industrialization and sustainable development.

3. OBJECTIVES

The objectives of the undergraduate Mechanical Engineering programme in Michael Okpara University of Agriculture, Umudike are to prepare its graduates to:

1. Design and make components, machines, equipment and systems with locally sourced materials towards global applications,
2. Develop problem-solving, analytical, and critical thinking skills for designing, manufacturing, optimizing, and maintaining mechanical systems in industries and research institutions.
3. Actively engage in design and develop of new production techniques and modify the existing ones for effective operation of the nation’s industries and other sectors
4. Be self-reliance with technical and managerial skills to establish and manage engineering-based businesses or other fields, such as education, science, public policy, politics or governance for sustainable development;
5. Participate in installation and maintenance of engineering systems that will perform optimally in our local environment,

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programmes through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.
- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.
- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programmes with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.
- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.
- **Performance Standards for COREN Indexing and Progression**
  Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
*FRE 114	Elementary French I	1	E	15	
*GER 115	Elementary German I	1	E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MEE 121	Introduction to Mechanical Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	
IGB 121	Readings and Practice in Igbo	1	C	15	-
*FRE 124	Elementary French II	1	E	15	
*GER 125	Elementary German II	1	E	15	-
	Total	**20**		**240**	**180**

*** Elective**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**

200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MEE 221	Engineering Metrology	2	C	15	45
MEE 222	Electronics of Mechanical Systems	2	C	15	45
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C		135
	Total	**21**		**240**	**225**

* **All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL-FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
MEE 311	Fundamentals of Mechanisms and Machines	2	C	15	45
MEE 312	Mechanical Engineering Design I	2	C	30	-
MEE 313	Manufacturing Technology	2	C	15	45
GET 311	Engineering Statistics and Data Analytics	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	45	-
	Total	**20**		**255**	**180**

300 LEVEL-SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
MEE 321	Computer Aided Design and Manufacture (CAD and CAM)	3	C	30	45
MEE 322	Engineering Metallurgy	2	C	15	45
MEE 323	Automotive and Autotronics Engineering	3	C	30	45
GET 321	Engineering Economics	3	C	45	
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technology	3	C	30	45
*GET 329	SIWES 1I	4	C	-	180
	Total	**20**		**240**	**180**

*** All SIWES credited in the 2nd Semester of 400-Level**

400 LEVEL-FIRST SEMESTER

Course Code	Course Title	Units	Status	LH	PH
MEE 411	Mechanical Engineering Design II	3	C	45	-
MEE 412	Mechanics of Machines	2	C	30	-
MEE 413	Applied Engineering Thermodynamics I	2	C	30	-
MEE 414	Applied Fluid Mechanics	2	C	30	-
MEE 415	Heat and Mass Transfer	3	C	45	-
MEE 416	Advanced Mechanics of Materials	2	C	30	-
MEE 417	Tool Design	2	C	15	45
MEE 418	Facilities and Work Systems Design	2	C	30	-
	Total	**18**		**255**	**45**

400 LEVEL-SECOND SEMESTER

Course Code	Course Title	Units	Status	LH	PH
MEE 421	Mechanical Engineering Laboratory	2	C	-	90
MEE 422	Mechanical Building Services	2	E	-	90
MEE 423	Health Safety and Environment (HSE I & II)	2	E	-	90
GET 421	Engineering Project I	2	C		90
GET 422	Engineering Valuation and Costing	2	C	30	-
*GET 229	SIWES I	3	C		135
*GET 329	SIWES II	4	C		180
*GET 429	SIWES III	4	C		180
	Total	**17**		**30**	**675**

*** All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MEE 511	Applied Design	3	C	30	45
MEE 512	Modeling and Simulation	3	C	30	45
MEE 513	Nano Technology	3	C	30	45
MEE 514	Applied Engineering Thermodynamics II	2	C	30	-
MEE 515	Control Systems	2	C	15	45
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
*MEE 590	B.Eng. Project	6	C	-	270
	Total	**18**		**210**	**180**
500 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MEE 521	Advanced Energy Systems	2	C	15	45
MEE 522	Advanced Manufacturing Processes	3	C	15	45
MEE 523	Industrial Automation and Robotics	2	E	15	45
MEE 524	Reliability Engineering	2	E	15	45
MEE 525	Refrigeration and Air Conditioning	2	E	15	45
GET 521	Engineering Management	3	C	45	-
*MEE 590	B.Eng. Project	6	C	-	270
	Total	**18**		**120**	**450**

*** MEE 590 credited in the 2nd Semester of 500-Level: Student must register minimum of two (2) final year elective courses**

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Unit C: LH 30)

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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 113.These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (Algebra and Trigonometry) (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behaviour of Matter) (2 Units C: LH 30)
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 117: General Practical Physics I (1 Unit C: PH 45)
treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

STA 112: Probability I (3 Units C: LH 45)
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

GST 111: Communication in English (2 Units C: LH 15; PH 45)
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, generalization and explanations). Ethical considerations, copyright rules and infringements. Writing activities: pre-writing (brainstorming and outlining). Writing (paragraphing, punctuation and expression). Post- writing (editing and proofreading). Types of writing (summary, essays, letter, curriculum vitae, report writing, note-making) etc. Mechanics of writing. Information and Communication Technology in modern language learning. Language skills for effective communication. The art of public speaking.

GST 112: Nigerian Peoples and Cultures (2 Units C: LH 30)
Nigerian history, culture and art up to 1800 (Yoruba, Hausa and Igbo peoples and cultures; peoples and cultures of the minority ethnic groups). Nigeria under colonial rule (advent of colonial rule in Nigeria; colonial administration of Nigeria). Evolution of Nigeria as a political unit (amalgamation of Nigeria in 1914; formation of political parties in Nigeria; nationalist movement and struggle for independence). Nigeria and challenges of nation building (military intervention in Nigerian politics; Nigerian Civil War). Concepts of trade and economics of self-reliance (indigenous trade and market system; indigenous apprenticeship system among Nigerian peoples; trade, skill acquisition and self-reliance). Social justice and national development (definition and classification of law); Judiciary and fundamental rights. Individuals, norms and values (basic Nigerian norms and values, patterns of citizenship acquisition; citizenship and civic responsibilities; indigenous languages, usage and development; negative attitudes and conducts [Cultism, kidnapping and other related social vices]). Re-orientation, moral and national values (The 3Rs – Reconstruction, Rehabilitation and Re-orientation; re-orientation strategies: Operation Feed the Nation (OFN), Green Revolution, Austerity Measures, War Against Indiscipline and Corruption (WAIC), Mass Mobilization for Self-Reliance, Social Justice and Economic Recovery (MAMSER), National Orientation Agency (NOA). Current socio-political and cultural developments in Nigeria.

LIB 116: Use of Library (1 Unit C: LH 15)
Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification

(LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L’heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES, GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit *E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

MEE 121: Introduction to Mechanical Engineering (2 Units C: LH 30)
Historical development of the mechanical engineering discipline. Philosophy and scope of contemporary mechanical engineering course programme. Overview of mechanical engineering special fields: applied (solid) mechanics, fluid and thermal engineering (thermodynamics and heat transfer). Industrial/production engineering and engineering management sciences. The linkage between mechanical engineering and other engineering disciplines and the sciences. The concept of innovation. Illustrations of a wide variety applications of mechanical engineering. The role of mechanical engineers in the society and human development. Professional ethical responsibility. Climate change, renewable energy and environmental sustainability.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design Thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modeling I (2 Units C: LH 15; PH 45)
Introduction to design thinking and engineering graphics. First and third angle orthogonal projections. Isometric projections; sectioning, conventional practices, conic sections and development. Freehand and guided sketching – pictorial and orthographic. Visualisation and solid modelling in design, prototyping and product-making. User interfaces in concrete terms. Design, drawing, animation, rendering and simulation work spaces. Sketching of 3D objects. Viewports and sectioning to shop drawings in orthographic projections and perspectives. Automated viewports. Sheet metal and surface modelling. Material selection and rendering. This course will use latest professional design tools such as fusion 360, solid works, solid edge or equivalent.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium, and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement:

Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (Calculus) (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (Vectors, Geometry and Dynamics) (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens's principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. ii)Classification of speech sounds: vowels and consonants. Understanding syllables: mono-syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit *E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit *E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30; PH 45)
Fundamental concepts: Electric fields, charges, magnetic fields. Current, B-H curves Kirchhoff's laws, superposition. Thevenin Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex j - notation, AC circuits, impedance, admittance and susceptance.

GET 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)
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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)

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

MEE 221: Engineering Metrology (2 Unit C: LH 15; PH 45)

History of metrology, Advancements in metrology, Gaging methods; Linear, angular, and diameter gaging. Standards and calibration. Non-contact gaging methods and measurement. In-line gaging and data collection, Unit conversions; English-Metric conversion and application, English-Metric Instrumentation, GD&T and inspection; Understanding datum and datum selection, Geometric characteristics and applications, Application modifiers, Interpretation and application of multiple datum control frames, Concepts of gage selection and GD&T; Gage selection process considerations, Gage selection GD&T consideration, Gage selection part configuration, Inspection

variables; Thermal impact on inspection, Material stability influence, Part configuration influence, case studies of quality assurance; Quality assurance and control failures, Concepts of non-contact inspection; Lasers, Optical comparators and vision systems, Industrial radiography, Non-destructive testing, Process interface to inspection; Process adjustment and compensation, In-line inspection, Elements of gaging care and calibration; Calibration and Adjustments, Cleaning and Maintenance, Repair and re-calibration, Elements of quality plans and metrology; Control plan for calibration, Identification and documentation, Traceability.

MEE 222: Electronics of Mechanical Systems (2 Units C: LH 15; PH 45)

Introduction to Semiconductor Devices, Diode characteristics, Types of diodes, Transistor characteristics (BJT), Transistor biasing circuits, Transistor switching and amplifiers, Integrator circuits, Operational Amplifiers and application. Open loop and close loop systems, Ideal characteristics, Golden rules, Inverting amplifier, Non Inverting amplifier, Summing amplifier, Differentiating amplifier, Differential amplifier, Integrator amplifier, Unity gain amplifier. Field Effect Transistor (FET) characteristics and applications, Logic circuits and their application. DC power supply ,Rectification, Smoothing and voltage stabilization, Ripple factor and efficiency**.** Electrical coupling and impedance matching, Power converters (Single-phase and 3-phase rectifiers and inverters).

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)

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 222: Engineering Materials (3 Units C: LH 45)

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 223: Engineering Mathematics II (3 Units C: LH 45)
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 224: Strength of Materials (3 Units C: LH 45)
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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and

stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centres in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

MEE 311: Fundamentals of Mechanisms and Machines (2 Units C: LH:15: PH: 45)
Introduction, Mechanical Science, Mechanical Joints, Degrees of Freedom, Inverse and Forward Problems, Kinematic Analysis, Force Analysis, Mathematical Preliminaries, Organization and Notations of the Lecture Notes, Position Analysis, Coordinate Transformation, Point Trajectories, Motion Constraints, Inverse Problem, Classical Kinematic Approach, Analysis of the Four-Bar Mechanism, Algebraic Constraint Equations, Velocity and Acceleration Analysis; Vector and Matrix Identities, Velocity Equations, Point Trajectories, Acceleration Equations, Inverse Problem, Classical Kinematic Approach, Graphical Approach, Motion of a Point on a Rigid Body, Singular Configurations, Algebraic Constraint Equations, Motion Transmission: Cams and Gears, Cams, Cam Displacement Diagram, Design of the Cam Profile, Cam Displacement Functions, Standard Cam Displacement Functions, Gears, Fundamental Law of Gearing, Involute Curve, Spur Gear Geometry and Design, Gear Trains, Epicyclic (Planetary) Gear Trains, Dynamics of Mechanisms and Machines; Newton-Euler Equations, D'Alembert's Principle, Computational-Dynamics Approach, Balancing, Spatial Kinematics, Euler Angles. Velocity and Acceleration Vectors, Spatial Newton-Euler Equations**.**

MEE 312: Mechanical Engineering Design I (2 Units C: LH 30)
Philosophy of engineering design and introduction to machine design: Sciences Involved; Components; units and assemblies of machines; main trends in developments of machine design. Selection of materials sequence in machine design. Loads in machines. Factor of safety. Allowable stress. Economy in design. Standards in machine design: N.S.O. and I.S.O. Standards, system of fits and limits. Dimensional and geometrical tolerance. Interchangeability. Surface texture; marking machine surfaces. Standard machine elements. Marking of riveted, welded and threaded joints on engineering drawing. Design of joints: Riveted joints: Friction effect; strong and tight-strong joints for structures and pressure vessels. Welded joints: Methods of welding; strength calculations of welded joints. Threaded joints: Classification; standards. Combined Loads. Forces and deformations of joined parts. Power screws; Strength and efficiency. Key and pin joints: Unstrained, Strained, fixed and sliding joints. Design Assignments on Jockey-Pulley Assembly drawing, Knuckle joint. Scope of the task: - Calculation, workshop and assembly drawings, technical description on production, operation and maintenance

MEE 313: Manufacturing Technology (2Units C: LH 30; PH: 45)
History of machining and machine tools. Lathes, drill press, millers and grinders. Turning and boring, drilling, reaming, milling, planning, shaping and grinding processes. Slotting and broaching, honing and lapping, gear cutting, cutting tool, cutting forces, cutting tool geometry,

tool failure and tool wear mechanisms, cutting fluid and surface finishing. Determination of spindle speeds and feed speeds, chippless material removal processes. Introduction of automation in manufacturing visualization fixtures. Machine tool installation, testing and maintenance. Workshop practicals based on topics covered. Foundry Practice: Pattern making, moulding, melting and pouring. Principles of solidification of metals and alloys, Design of gates and risers. Castings

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)

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

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

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

GET 313: Engineering Mathematics III (3 Units C: LH 45)

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

GET 314: Engineering Laboratory III (1 Unit C: PH 45)

Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators, and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies:

Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

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

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

MEE 321: Computer-Aided Design and Manufacture (3 Units C: LH 30; PH 45)

Introduction to computer aided design (CAD). Basic data structuring technique. Computer graphics. Geometric transformation techniques. Mathematical bases for surface modeling: curves, surfaces and solids. Principles of solid modeling and application. CAD software. Introduction to

CAM: Relation between production volume and flexibility. Various manufacturing systems – batch, mass, group, cellular and flexible manufacturing systems. Type of automation and benefits of soft or flexible automation. Automation in material handling and assembly. CNC machines: Introduction, classification, design and control features including interpolations. Numerical control and NC part-programming. Introduction to Robotics: Definitions, motivation, historical development. Basic structure, classification, workspace, drives, controls, sensors, grippers, specifications. Manual CNC programming (milling and turning). Basic and advanced CAD/CAM for CNC (milling and turning). Group project assignment.

MEE 322: Engineering Metallurgy (2 Units C: LH 15; PH 45)

Age-hardening and isothermal transformation processes, quenching and tempering hardenability and graphitization processes. Fracture mechanics applied to metals, ceramics and polymers, Dislocation x-ray and electron diffraction. Industrial metallurgy, corrosion and high temperature oxidation theories. Metal conversion: copper; aluminum, lead etc. Quenching of metals, glasses, polymer tiles, paper and wood. Transport processes, analysis of heat and mass in material processing operations. Composite Materials: Fiber reinforced composites. Stress, strain, and strength of composite laminate. Failure criterion. Design of composite structure and industrial application of composites**.**

MEE 323: Automotive and Autotronics Engineering (3 Units C: LH 30; PH 45)

This course introduces students to internal combustion engines, their efficiency and pollutants emission. It looks at the various emerging power technologies in the automotive industry and the current and alternative fuels and combustion processes. Choice of fuel and the design of efficient engine operating parameters and their by-products will also be discussed. Theory and practical works on automotive body work techniques: wheel balancing and alignment, routine maintenance, auto fault finding/trouble-shooting techniques and rectification procedures, test and performance analysis of auto systems. Body and chasis design. Introduction to Autotronics; Electronic engine and vehicle motion control systems; Design of algorithms/programs for treatment of automotive engineering problems. Fundamentals of SI and I.C. Engines cycles and their analysis. Fuels and Lubricants, properties of air-fuel mixtures, strength on ignition, flame formation, flame velocity, combustion rate, peak pressure and temperature. Engine emission and emission control. Advanced topics in autotronics engineering. Application of autotronics to I. C. Engine design and performance optimization. Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Ignition systems: Ignition fundamentals - Electronic ignition systems – Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection. Charging systems: Working and design of charging circuit diagram – Alternators– Requirements of starting system - Starter motors and starter circuits. Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors –study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator. Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU‟s used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles. Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system –climate control of cars.

GET 321: Engineering Economics (3 Units C: LH 45)

The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity, Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost, Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Acccounting Concepts-Double Entry system, Journal, Ledger, Trail balance, Final Accounts Book Keeping system, Depreciation - Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)

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

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30; PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

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

Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and solidWorks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; autoCAD mechanical, SPSS. A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.

Examples of projects should include the following:

a. Design of machine components;
b. Product design and innovation;
c. Part modelling and drafting in SolidWorks; and
d. Technical report writing.

MEE 411: Mechanical Engineering Design II (3 Units C: LH 45)
Journal bearings. Application of Hertz stress theory. Fluid couplings. Lubrication mechanics: hydrodynamic theory applied to tapered wedge and journal bearings and hydrostatic lubrication applied to journal bearings. Gears and power transmission systems. Elements of fluid power system design. Design of cylinders, pipes and pipe joints, tubes, plates and flywheel. Seals, packaging, gaskets and shields. Failure analysis; various types of joints, design of machine elements; system design, design of gear systems; material selection in design; design; design and production matching; optimization in design D.

MEE 412: Mechanics of Machines (2 Units C: LH 30)
Force analysis of mechanisms, fluctuation of kinetic energy and inertial effects. Complete static and dynamic analysis. Flexible shaft couplings: belt, rope and chain drives. The flywheel and mechanical governors. Brakes and dynamometers. Balancing of multi-cylinder engines. Balancing of machinery. Vibration of machinery; free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts and torsional vibrations problems.

MEE 413: Applied Engineering Thermodynamics I (2 Units E: LH 30)
Vapour compression cycle; Entropy; Clausius's Inequality; Tds relationship; Entropy of closed system; control volume isentropic process; Rotary compressors – centrifugal and axial-flow; stagnation properties. Rankine cycle with superheat and reheat; Regenerative vapour cycles; Gas Power systems: Simple gas turbine Regenerative as cycles; The steam power plant. Simple gas turbine plant; Exergy – Definition, equation of state, analysis, exergy balance of a closed system; Multistage reciprocating compressors. Combustion of fuels; chemistry of common hydrocarbon fuels, combustion with deficiency or excess air. Thermochemistry: Hess' Law of Heat Summation; heats of combustion and reaction; ideal adiabatic flame temperature. Reciprocating internal combustion engines. Otto cycle; General thermodynamics relations. Kinetic theory of gas. Mixture of gases. Introduction to heat transfer.

MEE 414: Applied Fluid Mechanics (2 Units C: LH 30)
Dimensional analysis and similitude; Kinematics and Dynamics of fluid motion; Continuity equation – momentum, annular momentum and energy equations; Euler and Bernoulli equations; Incompressible fluid between parallel plates, circular tubes and circular annuli; Laminar and turbulent flow in pipes, Fluid pressure and measurements – velocity and flow rates; Unsteady flow; Oscillation in U-tube; surge tank; water hammer. Open-channel flows. Introductory concepts of boundary layer and re-circulating flows, mathematical derivation of Navier-stokes equations and its application. Introduction to turbo machinery; characteristic curve for axial-flow and centrifugal pumps, fans, blowers, impulse and reaction turbines. Fluid couplings and lubrication mechanics; bearings; Lift and Drag principle; Boundary layer theory; Pump selection and application. Pipeline systems (Series and Parallel). Compressible flow; flow through heat exchange; Open channel flow. Overview of computational fluid dynamics (CFD).

MEE 415: Heat and Mass Transfer (3 Units C: LH 45)
Conduction and Convection heat transfer: Newton's and Fourier's Laws of heat transfer, general heat conduction equation, steady state conduction in one dimension, conduction and convention in three cartesian coordinates across plates, circular and cylindrical planes; heat transfer coefficients; Energy equation of convection. Continuity and momentum equations and their roles in convection heat transfer analysis. Convection heat transfer in laminar and turbulent flows.

Internal and external flows. Heat transfer coefficients. Dimensional analysis and dimensionless groups in convection heat transfer. Convection heat transfer correlations. Heat exchanger analysis and design; Logaritmic mean temperature; Radiation: intensity; Stefan-Boltzman law, Black and gray bodies, emission and absorption, Combined modes of heat transfer. Mass transfer: Mechanisms of mass transfer. Fick's law of mass diffusion. General diffusion law. Rate equations. Comparison of Fick's and Fourier's laws. Equations of mass transfer in stationary systems. Similarities between conduction and mass transfer in stationary systems. Mass transfer coefficient. Electrical analogy of mass transfer. Equimolal counter diffusion. Drying and humidification of solids and gases. Types of dryers. Evaporation. Mass transfer correlations in convective systems.

MEE 416: Advanced Mechanics of Materials (2 Units C: LH 30)
Thick cylinders; compound cylinders. Rotating disks. Bending of flat plates. Beams on an elastic foundation. Membrane stresses in shells of revolution. Two-dimensional theory of elasticity. Elastoplastic problems and limit theory.

MEE 417: Tool Design (2 Units C: LH 30:PH 45)
Tool Design, Materials Used for Tooling, Cutting Tool Design, Workholding Concepts, Jig Design, Fixture Design, Power Presses, Die Design and Operation, Inspection and Gage Design, Tool Design for Joining Processes, Modular and Automated Tool Handling, Computer Applications in Tool Design. Geometric Dimensioning and Tolerancing

MEE 418: Facilities and Work Systems Design (2 Units C: LH 30)
Facilities design function, product and process engineering. Flow analysis and design, facility layout using manual and computer routines. Facility location procedures, packaging and material handling system; theory and methods of locating facilities plant and warehouse siting, emergency service sites, vehicle and hazardous material routing, distribution systems design. Planar single and multi-facility models, network location problems, cyclical networks. Productivity, effect of productivity and standard of living and economic development. Techniques for increasing productivity; work study and its advantages. Basic procedure for method of study, use of charts and symbols; factory/shop layout; examples of method study. Basic procedure for work measurement, time study, ratio delay/activity sampling method. Effect of working conditions e.g. cleanliness, lighting, ventilation, wise, and safety precautions. Value Engineering. Energy policy and planning. Organizational structure, information Technology (IT) and performance; Networking. Industrialization and economic development of developing and developed countries. Sources of funds for financing investments, infrastructures (social and economic) standard of living. Group technology tasks involving improvement on the productivity of systems.

MEE 421: Mechanical Engineering Laboratory (1 Unit C: PH 45)
Laboratory sessions involving topics covered in MEE 413, MEE 414, MEE 415 and MEE 416

MEE 422: Mechanical Building Services (1 Units: C; PH 45)
Introduction to building services. Mechanical building services: water supply; plumbing and drainage; heating, ventilation and air conditioning (HVAC) systems, fire protection systems, etc. Building maintenance management. Regulatory and professional practices related to both design and maintenance of buildings.

MEE 423: Health Safety and Environment (HSE I &II) (2 Units: C; PH 90)

HSE I: Introduction to HSE (Overview of HSE in engineering practices, Importance of HSE in engineering projects, HSE regulations and standards). Hazard Identification and Risk Assessment (Hazard identification techniques, Risk assessment methodologies, Hazard control and mitigation measures). HSE Management Systems (HSE management system framework, Policy, planning, and implementation, Monitoring, review, and continuous improvement). Occupational Health and Safety (Occupational health hazards, Safety management systems, Emergency response planning) HSE II: Environmental Impact Assessment (Environmental impact assessment methodologies, Environmental legislation and regulations, Sustainable development principles). Waste Management and Pollution Control (Waste management strategies, Pollution control measures, Environmental monitoring and reporting). Fire Safety and Emergency Response (Fire safety principles, Fire risk assessment and management, Emergency response planning and procedures). Case Studies and Group Projects (Real-life case studies of HSE in engineering projects, Group projects on HSE management systems and emergency response planning).

GET 421: Engineering Project I (2 Units C: PH 90)

In the second semester of the 400-level students, preferably in groups, work from the University on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organisation/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units C: LH 30)

Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)

On-the-job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc., for a period of 6 months under the guidance of appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

MEE 511: Applied Design (3 Units C: LH 30; PH 45)

Scientific Design Methodology: creative application of the design process to engineering problems with emphasis on the manufacture of complete systems to accomplish overall objectives of minimum weight, high efficiency while satisfying the design constraints. An appreciation of the process of engineering design, and of systematic procedures and tools usable in the design process, with particular reference to mechanical systems and devices. Topics include systematic problem definition, search for possible solutions, statistical analysis of stress/strength interference, experiment planning techniques, optimum design for minimum weight and cost, and management of the design process. Design Project: Students will be required to conduct a design project under supervision, using the presented techniques, and taking at least to a workable layout drawing of a device. The design should involve simple mechanical systems (e.g. testing and assembling devices, heat drive, etc.) for a specified duty, analyse its operating conditions and after considering the design criteria, choose between potential solutions. Reports submitted by students should contain all calculations, a comparison of potential solutions, justification for the design finally chosen, and instructions on detail design, manufacture, testing and use. Use and evaluation of several CAD/CAM software packages. Students will gain experience with CAD/CAM software while carrying out an actual manufacturing design project.

MEE 512: Modeling and Simulation (3 Units C: LH 15; PH 45)

Development of the fundamental simulations modeling concept and frame work. System-theoretic model development principles and methods, component-based simulation and modeling tools. Simulation experimentation and analysis, Network system simulation modeling, multi-resolution, multi-aspect modeling, Parallel simulation modeling concept and methods. Simulation model verification and validation. Monte-Carlo techniques and computer usage. Software development. Study of the theory and applications of special purpose simulation languages to model, analyze, and design industrial and engineering systems. Stochastic and deterministic method; discrete event stochastic; models. Markov models with application to queuing models.

MEE 513: Nano Technology (3Units C: LH 30; PH: 45)

Fundamental concepts in nano-science and Nano technology. Review of quantum mechanics. Nano-systems. Molecular dynamics. Scanning probe microscopy. Nano-materials. Production and characterization of nanoparticles. Design of nanostructured systems. Nano-mechanics of materials, Applications of nano-systems in the industry. Carbon Nano fibres, Nano-composites.Fabrication methods. Computational nanotechnology.

MEE 514: Applied Engineering Thermodynamics II (2 Units C: LH 30; PH 45)

Non-ideal pure substances. Equations of state and compressibility factors. General thermodynamic relations-Maxwell's relation, T-ds equations, Clausius-Claperon equation, difference in heat capacities, Joule Thompson's coefficient, Mixtures and solutions; Fugacity and activity coefficients. Thermodynamics of chemical reactions, first law and second law analyses of reacting systems. Dissociation and equipment constants. Introduction to phase and chemical equipment; Practical cycles: refrigerants vapour compression, gas, water and absorption cycles. Design methods; refrigeration loads, equipment selection. Refrigeration and Air conditioning processes; Psychometrics: Psychometric process, analysis-using psychometric charts. Cooling and Load calculations, Air-condition design, equipments selection and evaluations: ducts, fan throttling systems and Physiological principles and comfort indices, relative humidity, wet bulb temperature. Introduction to Food refrigeration and Cryogenics.

MEE 515: Control Systems (2 Units C: LH 30; PH 45)

Historical development of automatic control. Control systems; open and closed-loop control systems, characteristic of feedback, control media and control system components. Digital systems. Mathematical modeling of control systems. Transfer functions, block diagrams and signal flow graph. Time domain analysis, transient response, steady-state error, stability and sensitivity. Routh's stability criterion. Root locus. Frequency domain analysis, Ny-quist criterion, Bode plots and Nicholas charts. Signals: continuous- and discrete-time signals difference equations, z-transform; sampled-data systems, sample and hold, discrete models including state-space; discrete equivalents of continuous-time systems; stability analysis; controllability and observability of sampled-data systems; design specification; controller design using transform techniques, design using state-space methods; generalized sample-data hold functions. Control system design by compensation. Introduction to optimal control. Analysis of mechanical, pneumatic, hydraulic, hybrid feedback control systems. Control systems of power plants.

GET 511: Engineering Project Management (3 Units C: LH 45)

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

GET 512: Engineering Law (2 Units C: LH 30)

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

MEE 521: Advanced Energy Systems (2 Units C: LH 15; PH 45)
Advanced energy conversion technologies: Natural gas combined cycle, alternatively-fueled combined cycle (i.e., coal or biomass in integrated gasification combined cycle), supercritical Rankine cycle, biomass combustion systems, nuclear, and fuel cells, fossil fuels, renewable energy and advanced energy materials. Energy storage systems. Energy systems analysis, modeling and optimization**:** Availability analysis approach, Determination of extractable maximum possible work from energy resource, optimization of complex energy systems that work potential is destroyed by irreversibility based on idea that all energy resources have the potential to do work by virtue of being out of equilibrium (thermal, mechanical and chemical) with the environment, Application of AI/machine learning and smart grids to energy system performance optimization, Energy efficiency and demand response strategies**.** Energy Policy and Regulations**.** Sustainable energy development for electric power generation, transportation, emissions reduction, carbon capture, utilization and storage.

MEE 522: Advanced Manufacturing Process (3Units C: LH 30; PH 45)
Non-traditional machining, Additive manufacturing, Rapid prototyping and tooling, Micro and nano fabrication technologies, Manufacturing process modeling, simulation, selection and optimization, Lean manufacturing and Six Sigma. Practical sessions: Hands-on experience with different types manufacturing equipment, CAD/CAM software for designing and preparing parts for manufacturing and CNC programming for controlling automated manufacturing machines

MEE 523: Industrial Automation and Robotics (2 Units C; LH 15; PH 45)
Economics of Automation. Flow Lines and Mathematical Models; Storage Buffers and Partial Automation; Balancing Techniques. Group Technology and Flexible Manufacturing Concepts. Introduction to PLCs and Their Advantages, and Ladder Logic Diagrams and Switching Logic. PLC Data Communication and Human Machine Interfaces (HMI). PLC Connection and Operation. PLC Numbering and Addressing. General Information and Operations of CNC machines, including Control Panel Descriptions and Tool Functions. Practical Application of Tool Wear Offset, Feed Function, and Spindle Function. CNC Program Creation and Preparatory Functions. Computer-Assisted Part Programming and APT Programming System. CAD/CAM Approach to Part Programming and Applications (Turning, Surface Milling, Machining of Curved Surfaces).

MEE 524: Reliability Engineering (2 Units E: LH 15; PH 45)
Review of international quality standards (ISO 9000, etc.). Proactive and reactive quality assurance and quality control techniques; emphasis on quality planning, statistical process control (SPC), acceptance sampling and total quality management (TQM). Introduction to reliability and maintainability engineering. Study and application of statistical models and methods for defining, measuring, and evaluating reliability of products, processes, and services; emphasis on reliability functions (e.g., failure rate, mean time to failure), reliability configurations (e.g., series, parallel, complex systems), reliability estimation (e.g., parametric, non-parametric methods), reliability improvement techniques. Continuous improvement techniques for quality and reliability; Leadership and training issues in quality and reliability engineering; emphasis on statistical process control (SPC) for continuous improvement, total quality management (TQM) principles, leadership styles and strategies for quality and reliability improvement, Training and development programs for quality and reliability engineers

MEE 525: Refrigeration and Air conditioning (2 Units E: LH 15; PH 45)
Refrigeration and Air conditioning processes; Psychometrics: Psychometric process, analysis-using psychometric charts. Cooling and Load calculations, Air-condition design, equipments selection and evaluations: ducts, fan throttling systems and Physiological principles and comfort indices, relative humidity, wet bulb temperature. Introduction to Food refrigeration and Cryogenics. Steam piping and heating systems.

GET 521: Engineering Management (3 Units C: LH 45)
Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

MEE 590: B.Eng. Project (6 Units C: LH/PH 270)
Final-year projects are assigned at the beginning of each academic year. Each final year student chooses a project supervisor in consultation with the final-year project coordinator. The process is entirely interactive, but the coordinator ensures that there is an even distribution of students amongst the lecturers. The final topic is decided by the student and his supervisor, selected from the fields of mechanics of solids and fluids, materials science, machine design, heat power, heat transfer, production technology, industrial engineering and management. Each student presents at least two seminars as part of their final year project, usually at the beginning and ending of the second semester. Each student is required to submit a report of their findings and undergo an oral examination. All seminars are scored by a panel of lecturers.

DEPARTMENT OF MECHATRONICS ENGINEERING
Bachelor of Engineering (B.Eng.) in Mechatronics Engineering

1. OVERVIEW OF DEPARTMENT OF MECHATRONICS ENGINEERING

The Department of Mechatronics Engineering in the College of Engineering and Engineering Technology of Michael Okpara University of Agriculture Umudike offers comprehensive undergraduate and graduate programs that span from fundamental research in mechanical, electronic, computer and control systems to innovative studies in artificial intelligence, robotics, machine learning and computer programming. Our program emphasizes the design and development of smart, simpler, more economical and reliable systems, production of high-quality systems and equipment with high precision and accuracy and improved production processes through automation. Undergraduate students in our Mechatronics Engineering program engage in cutting-edge research on advanced mechanics of composite structures, automotive systems, biomechatronic, and biomedical applications. Key areas of study include robotics, autonomous systems, AI-driven automation, and smart material applications. The programme has a unique balance of critical analytical subjects and professional skills, which enables students to graduate with the confidence to face challenging engineering situations in the industry. The management skills necessary to operate successfully as a multidisciplinary engineer in modern industry are promoted and developed at all the stages of the course. Our research is strongly interdisciplinary, with robust connections to Applied Mathematics, Applied Physics, Earth and Planetary Sciences, Chemistry and Chemical Biology. The students have the opportunity to work closely with renowned faculty members on groundbreaking interdisciplinary research projects from 400level, preparing them for leadership roles in academia, industry, and beyond.

2. PHILOSOPHY

The philosophy of the Mechatronics Engineering programme is to produce graduates with sufficient skills in the design and implementation of intelligent, automated solutions who will lead the transformation of key sectors such as manufacturing, agriculture, energy, health, and infrastructure through smart, sustainable, and inclusive engineering solutions, in accordance with National and Global community values and standards.

3. OBJECTIVES

The program's overall objective is to provide students with a strong interdisciplinary knowledge in mechanical, electrical, electronic, and computer engineering, enabling graduates to integrate and apply this knowledge in solving real-world engineering problems, through the design and development of intelligent automated systems capable of accomplishing specific tasks or challenges. Upon successful completion of the Mechatronics Engineering program, graduates will be able to:

1. Demonstrate a strong grasp of mechanical, electrical, electronics, computer, and control systems engineering, and apply this knowledge in designing and analyzing mechatronic systems.
2. Design, build, and troubleshoot automated and intelligent systems using sensors, actuators, microcontrollers, embedded systems, and software tools.

3. Identify engineering problems and develop innovative, efficient, and sustainable solutions using modern engineering tools and techniques.
4. Collaborate across engineering domains, communicate clearly, and contribute effectively as a team member or leader in project-based environments.
5. Use industry-standard software and hardware tools to model, simulate, and implement engineering solutions.
6. Stay current with rapidly evolving technologies in robotics, automation, IoT, and AI, and demonstrate a commitment to continuous professional development.
7. Uphold ethical standards in engineering practice, consider the societal and environmental impact of engineering decisions, and contribute responsibly to the profession.
8. Be well-prepared for employment in diverse engineering sectors, start their own tech ventures, or pursue graduate studies and research in related fields.

4. ADMISSION AND COREN INDEXING REQUIREMENTS

Candidates are admitted into the Bachelor of Engineering degree programme through three (3) modes: Unified Tertiary Matriculation Examination, Direct Entry or Inter-University Transfer modes

- **Unified Tertiary Matriculation Examination (UTME) Mode for Five (5)-Year Full-Time Programme**
  For the five-year degree programme, in addition to acceptable passes in the Unified Tertiary Matriculation Examination, the minimum admission requirement is credit level passes in Senior School Certificate (SSC) in at least five (5) subjects, which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject at not more than two (2) sittings.

- **Direct Entry (DE) Mode for Four (4)-Year Full-Time Programme**
  Candidates with good National Diploma (ND: Upper credit pass and above) in relevant Engineering Technology programmes in addition to five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 200 level.

- **Direct Entry (DE) Mode for Three (3)-Year Full-Time Programme**
  Holders of upper credit pass and above at Higher National Diploma (HND) level in relevant Engineering Technology programs with five (5) Senior School Certificate (SSC) credit passes which must include: English Language, Mathematics, Physics, Chemistry and any other acceptable science subject obtained at not more than two (2) sittings are eligible for admission into 300 level.

- **Inter-University Transfer Mode for Minimum of Three (3)-Years Full-Time Residency**
  A student undergoing undergraduate degree programme in another recognized University may be considered for admission on transfer provided he/she meets the minimum admission requirements of this University, possesses a minimum CGPA of 3.00 and seeks transfer to a programme similar to the one he/she is transferring from. The University deserves the right to conduct a security check on any prospective transfer student.

- **Performance Standards for COREN Indexing and Progression**

Students must pass at least 75 % of the Credit Units in Mathematics, Physics and Chemistry with a minimum Cumulative Grade Point Average (CGPA) of 2.40 to proceed from 100 to 200 Level and qualify for indexing by the Council for the Regulation of Engineering in Nigeria (COREN) and 1.50 to proceed to the next Level from 200 to 500 Levels. Also, a student must offer and pass all the compulsory courses and registered elective courses with a minimum CGPA of 1.50 before graduation.

5. COURSE OUTLINE

100 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 111	Engineer in Society	1	C	15	-
CHM 113	General Chemistry I	2	C	30	-
CHM 114	General Practical Chemistry I	1	C	-	45
MTH 112	Elementary Mathematics I	2	C	30	-
PHY 111	General Physics I	2	C	30	-
PHY 113	General Physics III	2	C	30	-
PHY 117	General Practical Physics I	1	C	-	45
STA 112	Probability 1	3	C	45	
GST 111	Communication in English	2	C	15	45
GST 112	Nigerian Peoples and Culture	2	C	30	-
LIB 116	Use of Library	1	C	15	-
IGB 111	Basic Igbo Literacy	1	C	15	-
FRE 114	Elementary French I	1	*E	15	-
GER 115	Elementary German I	1	*E	15	-
	Total	**20**		**255**	**135**
100 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 121	Introduction to Mechatronics Engineering	2	C	30	-
GET 121	Design Thinking and Innovation	1	C	15	-
GET 122	Engineering Graphics & Solid Modeling I	2	C	15	45
GET 123	Engineering Laboratory I	1	C	-	45
CHM 121	General Chemistry II	2	C	30	
CHM 124	General Practical Chemistry II	1	C	-	45
MTH122	Elementary Mathematics II	2	C	30	-
MTH 123	Elementary Mathematics III	2	C	30	-
PHY122	General Physics II	2	C	30	-
PHY 124	General Physics IV	2	C	30	-
PHY 127	General Practical Physics II	1	C	-	45
ENG 121	Use of English	1	C	15	-
IGB 121	Readings and Practice in Igbo	1	C	15	-
FRE 124	Elementary French II	1	*E	15	-
GER 125	Elementary German II	1	*E	15	-
	Total	**20**		**240**	**180**

200 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
GET 211	Applied Electricity I	3	C	30	45
GET 212	Engineering Graphics & Solid Modeling II	2	C	15	45
GET 213	Engineering Mathematics I	3	C	45	-
GET 214	Applied Mechanics	3	C	45	-
GET 215	Students Workshop Practice	2	C	15	45
GET 216	Fundamentals of Thermodynamics	3	C	45	-
ENT 211	Entrepreneurship and Innovation	2	C	30	-
GST 217	Philosophy, Logic and Human Existence	2	C	30	-
	Total	**20**		**255**	**135**
200 LEVEL - SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 221	Algorithm and Data Structures	2	C	30	-
GET 221	Computing and Software Engineering	3	C	30	45
GET 222	Engineering Materials	3	C	45	-
GET 223	Engineering Mathematics II	3	C	45	-
GET 224	Strength of Materials	3	C	45	-
GET 225	Fundamentals of Fluid Mechanics	3	C	45	-
GET 226	Electrical and Electronics Engineering Laboratory	1	C	-	45
GET 227	Engineering Laboratory II	1	C	-	45
*GET 229	SIWES 1	3	C	-	135
	Total	**19**		**240**	**135**

* **All SIWES credited in the 2nd Semester of 400-Level**

300 LEVEL - FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 311	Design of Mechatronics and Robotics Systems I	2	C	30	-
MCE 312	Electronic Circuits and Devices for Robotics I	1	C	15	-
MCE 313	Mechanisms and Motion Systems	2	C	30	-
GET 311	Engineering Statistics and Data Analytics	3	C	45	-
GET 312	Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies	3	C	45	-
GET 313	Engineering Mathematics III	3	C	45	-
GET 314	Engineering Laboratory III	1	C	-	45
ENT 312	Venture Creation	2	C	15	45
GST 312	Peace and Conflict Resolution	2	C	30	-
	Total	**19**		**255**	**90**
300 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 321	Commercial Technology Development	2	C	15	45
MCE 322	Computer Integrated Manufacturing (CIM)	2	C	15	45
MCE 323	PLC Fundamentals and Programming	2	C	30	-
GET 321	Engineering Economics	3	C	45	-
GET 322	Technical Writing and Communication	3	C	45	-
GET 323	Engineering Mathematics IV	3	C	45	-
GET 324	Renewable Energy Systems and Technology	3	C	30	45
*GET 329	SIWES II	4	C		180
	Total	**18**		**225**	**135**

400 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 411	Computer Vision and Image Processing	2	C	30	-
MCE 412	Micro controller and Embedded Systems	2	C	30	-
MCE 413	Control Engineering	2	C	15	45
MCE 414	Industrial Automation & Control	2	C	30	-
MCE 415	Sensors and Actuators	2	C	30	-
MCE 416	Instrumentation Engineering	3	C	45	-
MCE 417	Electronic Circuits and Devices for Robotics II	2	C	30	-
MCE 418	Fluid Power Systems	3	C	45	-
	Total	**18**		**255**	**45**
400 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 424	Mechatronics Laboratory II	2	C	-	60
GET 421	Engineering Project I	2	C	-	90
GET 422	Engineering Valuation and Costing	2	C	30	-
GET 229	SIWES I	3	C		135
GET 329	SIWES II	4	C		180
GET 429	SIWES III	4	C		180
	Total	**17**		**30**	**645**

*** All SIWES credited in the 2nd Semester of 400-Level**

500 LEVEL-FIRST SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 511	Design of Mechatronics and Robotics Systems II	2	C	-	90
MCE 512	Signals and Systems	3	C	45	-
MCE 513	Design of Machine Elements	3	C	30	45
MCE 514	Communication Engineering	3	C	30	45
MCE 515	Rapid Prototyping	2	C	30	45
GET 511	Engineering Project Management	3	C	45	-
GET 512	Engineering Law	2	C	30	-
**MCE 590	B. Eng. Project	6	C	-	270
	Total	**18**		**210**	**225**
Although the 6 units of MCE 590-B. Eng Project is not added to the 500 level first semester credit units, it lasts for the whole academic session and credited in the second semester					
500 LEVEL-SECOND SEMESTER					
Course Code	**Course Title**	**Units**	**Status**	**LH**	**PH**
MCE 521	Quality Control Methods for Product Reliability and Safety	3	C	45	-
GET 521	Engineering Management	3	C	45	-
*MCE 590	B. Eng Project	6	C	-	270
Choose minimum of three (3) electives					
MCE 522	Micro-Fabrication Technology	2	E	15	45
MCE 523	Computer Hardware Engineering	2	E	15	45
MCE 524	Power Electronics and Drive Systems	2	E	15	45
MCE 525	Mobile Robotics	2	E	15	45
	Total	**18**		**135**	**405**

MCE 590-B. Eng Project credited in the second semester

6. COURSE SYNOPSIS

GET 111: Engineer in Society (1 Unit C: LH 15)

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.

CHM 113: General Chemistry I (2 Units C: LH 30)

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 114: General Practical Chemistry I (1 Unit C: PH 45)
Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

MTH 112: Elementary Mathematics I (2 Units C: LH 30)
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.

PHY 111: General Physics I (Mechanics) (2 Units C: LH 30)
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 113: General Physics III (Behavior of Matter) (2 Units C: LH 30)
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; Bernoulli's equation and incompressible fluid flow; surface tension; adhesion, cohesion, viscosity, capillarity, drops and bubbles.

PHY 117: General Practical Physics I (1 Unit C: PH 45)
This introductory course emphasizes quantitative measurements. Experimental techniques. The treatment of measurement errors. Graphical analysis. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc. (covered in PHY111and 113). However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis, and deduction.

STA 112: Probability I (3 Units C: LH 45)
Permutation and combination. Concepts and principles of probability. Random variables. Probability and distribution functions. Basic distributions: Binomial, geometric, Poisson, normal and sampling distributions; exploratory data analysis.

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

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)

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

LIB 116: Use of Library (1 Unit C: LH 15)

Introduction and Historical Background of Libraries: Evolution and significance of libraries, The role of libraries in education and research, The Michael Okpara University of Agriculture, Umudike Library system. Types of Libraries and Their Resources: Academic, public, special, and national libraries, Print and non-print materials, Digital and electronic resources. Library and Education: The relationship between libraries and academic success, Role of the library in self-directed learning, Enhancing research and innovation through libraries. Library Study Skills: Note-taking and summarization techniques, Effective reading and comprehension strategies, Time management for academic success. Library Resources and Organization: Structure of an academic library, Arrangement and classification of resources, The role of librarians in information management. Using Library Resources: Print and Electronic: Accessing books, journals and reference materials, Digital libraries and online repositories, Utilizing institutional e-learning resources. Library Search, Cataloguing and Classification Schemes: The Dewey decimal classification (DDC), The Library of Congress Classification

(LCC), OPAC (Online Public Access Catalogue) and other search tools. Databases and Digital Research Tools: Introduction to academic databases (e.g., Google Scholar, JSTOR, ResearchGate, etc.), Open access journals and institutional repositories. Evaluating sources for credibility and reliability. Research Writing and Academic Techniques: Structuring academic papers and reports, Formulating research questions, Literature review techniques. Bibliographic Citation and Referencing Methods: APA, MLA, Chicago, and Harvard citation styles, Managing citations with software tools (e.g., Mendeley, Zotero, EndNote), The importance of proper referencing in academic writing. Plagiarism and Academic Integrity: Understanding plagiarism and its consequences, Techniques for paraphrasing and summarizing, Ethical considerations in research. Copyright Laws and Intellectual Property Rights: Understanding copyright regulations, Fair use policies and restrictions, Copyright implications in academic research. Conducting Internet and Web-Based Research: Effective internet search strategies, evaluating online sources for accuracy and reliability. The role of artificial intelligence and search engines in research

IGB 111: Basic Igbo Literacy (1 Unit C: LH 15)

Igbo alphabets, Parts of speech: Nouns and pronouns, Parts of speech: Preposition and conjunctions, Parts of speech: Adjectives, Adverbs and verbs, Interrogatives, numerals and exclamation, Phrases and tones, Clauses, Affixation, Punctuation marks, Sentence types, Morphemes, Igbo literature: Teaching of Igbo culture, Igbo songs and poetry.

FRE 114: Elementary French I (1 Unit *E: LH 15)

French Culture and Civilization: Importance of French language in Nigeria, Overview of Francophone countries and their relationship with Nigeria. Knowledge of France: Introduction to France’s history and major major cities, Contribution of France to Development of Science, Technology and Agriculture; Medicine and biology; Physics, chemistry and engineering; Agriculture, clothing and Food processing; Mathematics; Arts, communication and Computers; Philosophy. AGRICULTURE (L'AGRICULTURE): Position of France in agricultural produce, Definition of some related agricutral terms, Quelques verbes utilisent dans L’agriculture (Some verbs used in agriculture), Les outils et machines agricols (Some agricultural tools and machines), Some Educational terms in English and French, Some French verbs associated with education, Informatique et la technologie d'information, Verbs associated with ICT. ENGINEERING (GENIE): Genie Chimique (Chemical Engineering), Genie Electrique (Electrical Enginnering), Mechanical Engineering (Genie Mecanique), Génie Civile (Civil Engineering), Les sciences naturelles, Physiques et Appliques (Natural, Physical and Applied Sciences), La Santé et La Médicine (Health and medicine), L'Economie (Economics), Le Tourisme (Tourism). INTRODUCTION A LA PHONETIQUE (INTRODUCTION TO PHONETICS: The French Alphabet and accents, Spellings and pronunciation, Classroom pronunciation practice. LES SALUTATIONS ET FORMULES DE POLITESSE (GREETINGS AND POLITE REMARKS: Common greetings and self-introduction, Asking about Someone's wellbeing, Introduction of Self and others, (Metiers/Professions) Occupation/professsions, Introducing someone (Presenter quelqu'un), Nationality, Address, place and Date of birth, Countries and their nationals, (residential Address) Domicile, (Place of birth) lieu de naissance, Les nombres: cardinaux et ordinaux (Numbers : cardinal and ordinal), (Telling time, Day, Month, Year, and date) Dire L’heure, Les jours, Les mois et les années). LES OBJETS UTILISESS DANS LA CLASSE, ARTICLES,

GENRES, PREPOSITIONS (OBJECTS USED IN THE CLASSROOM, ARTICLES, GENDER AND PREPOSTIONS

GER 115: Elementary German I (1 Unit *E: LH 15)
Introduction to German Language, Pronunciation of German alphabets and special characters (ä, ö, ü, ß), Personal pronouns and auxiliary verbs (sein, haben, werden). Greetings and Personal Information, Common greetings and self-introduction, Asking and answering personal details (name, age, nationality, profession). Numbers, Dates and Time, Counting from 0 to 1 billion, Ordinal numbers and telling time, Days, months, seasons and their significance in agriculture. Articles, Nouns, and Cases, Definite and indefinite articles, Singular and plural forms, Basic introduction to nominative, accusative, dative and genitive cases.

MCE 121: Introduction to Mechatronics Engineering (2 Units C: LH 30)
Introduction to mechatronics systems -- Measurement Systems, Control Systems, Microprocessor-based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Level. Temperature, Light Sensors – Selection of Sensors. Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – DC Motors – AC Motors – Stepper Motors. Introduction to Robot and Robotics, Three laws of robotics, History, Issues of industrial robot usage, Robot Types, limitations, Architecture and Configuration of Robots, Applications of Robots, Robots Classification, Robot Repeatability and Accuracy, Robot component, Degree of freedom, Drive Technologies, Coordinate Systems, three related frames, Rotational about fixed frames (x,y,z). Transformation of Coordinate Frame, Forward Kinematics, Orientations, Translation of rigid body. Introduction to robotics, mobile robots, swamp robot and industrial robots, Robot Mechanisms, Actuators and Drive Systems, Differential Motion, Statics and dynamics, Force and Compliance Controls, Realistic and Safe Use of Robots.

GET 121: Design Thinking and Innovation (1 Unit C: LH 15)
Introduction to Design and Problem Solving in Engineering. Principles of Teamwork and Collaboration in Design. Breaking down complex Engineering problems. The Engineering Design Process: From Need to Concept. Problem Definition and Stakeholder Analysis. Brainstorming, Ideation, and Concept Selection. Modeling and Prototyping Techniques (Sketching, CAD, Simulations). Team Presentations on Concept Development. Systems Thinking and Integration in Mechatronic Design. Design Thinking suite of methods and techniques applied to project lifecycles with an emphasis on interdisciplinary practice. Ethical and Social Impact of Engineering Solutions. Final Project Work and Peer Feedback. Final Team Presentations and Design Review.

GET 122: Engineering Graphics and Solid Modeling I (2 Units C: LH 15; PH 45)
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. Visualization 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.

GET 123: Engineering Laboratory I (1 Unit C: PH 45)
Introduction to Laboratory Practices, Safety Procedures, and Report Writing. Measurement Techniques and Error Analysis (Length, Mass, Volume, Time, Temperature). Use of Vernier Calipers, Micrometers, and Multimeters. Force, Equilibrium, and Vector Analysis. Newton's Laws and Friction. Oscillations and Simple Harmonic Motion. Ohm's Law and Series/Parallel Circuits. Kirchhoff's Laws and Network Theorems. Basic Data Acquisition: Introduction to Sensors and Arduino. Arduino IDE installation and basics. Hydrostatic Pressure and Bernoulli's Principle. Stress-Strain Relationship. Thermal Conductivity and Heat Loss. Basic Signal Measurement: Oscilloscope and Signal Generator Use. Overview of robotics components. DC motor and servo motor control using motor drivers (e.g., L298N). Final Report Submission and Review.

CHM 121: General Chemistry II (2 Units C: LH 30)
Historical survey of the development and importance of organic chemistry; fullerenes as fourth allotrope of carbon, uses as nano tubules, nanostructures, nano chemistry. 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 124: General Practical Chemistry II (1 Unit C: PH 45)
Continuation of CHM 114. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

MTH 122: Elementary Mathematics II (2 Units C: LH 30)
Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

MTH 123: Elementary Mathematics III (2 Units C: LH 30)
Geometric representation of vectors in 1-3 dimensions, components, direction cosines. Addition, scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two dimensional co-ordinate geometry. Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals. Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles and resisted vertical motion. Elastic string and simple pendulum. Impulse, impact of two smooth spheres and a sphere on a smooth surface.

PHY 122: General Physics II (Electricity and Magnetism) (2 Units C: LH 30)
Forces in nature. Electrostatics (electric charge and its properties, methods of charging). Coulomb‘s law and superposition. Electric field and potential. Gauss‘s law. Capacitance. Electric dipoles. Energy in electric fields. Conductors and insulators. DC circuits (current, voltage and resistance). Ohm‘s law. Resistor combinations. Analysis of DC circuits. Magnetic fields. Lorentz force. Biot-Savart and Ampère‘s laws. Magnetic dipoles. Dielectrics. Energy in magnetic fields. Electromotive force. Electromagnetic induction. Self and mutual inductances. Faraday and Lenz‘s laws. Step up and step-down transformers. Maxwell's equations. Electromagnetic oscillations and waves. AC voltages and currents applied to inductors, capacitors, and resistance.

PHY 124: General Physics IV (Vibration Waves and Optics) (2 Units C: LH 30)
Simple harmonic motion (SHM). Energy in a vibrating system. Damped SHM. Resonance and transients. Coupled SHM. Q values and power response curves. Normal modes. Waves (types and properties of waves as applied to sound). Transverse and longitudinal waves (superposition, interference, diffraction, dispersion, polarization). Waves at interfaces (energy and power of waves). The wave equation. 2-D and 3-D wave equations. Wave energy and power. Phase and group velocities. Echo and beats. The Doppler-effect. Propagation of sound in gases, solids and liquids and their properties. Optics: Nature and propagation of light. Reflection and refraction. Internal reflection. Scattering of light. Reflection and refraction at plane and spherical surfaces. Thin lenses and optical instruments. Wave nature of light. Dispersion. Huygens’s principle (interference and diffraction).

PHY 127: **General Practical Physics II (1 Unit C: PH 45)**
This practical course is a continuation of PHY 117 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.

ENG 121: Use of English (1 Unit C: LH 15)
Vocabulary Development: Exploring registers and levels of usage in different fields such as medicine, military, communication, marketing, Law, Literature, Agriculture and Sciences, Direct and indirect speech. Figures of speech: Understanding and application of smile, metaphor, personification, apostrophe, metonymy, synecdoche, hyperbole, climate, euphemism, irony, paradox and oxymoron. Writing Skills: Letter writing - formal, informal, semi- formal, Essay writing, Report writing, Article writing, letters to editors and speech writing techniques. Book Review: A literary book will be assigned at the beginning of the semester. Discussions and reviews to be guided by the instructor. Oral Communication: Introduction to Phonetics and Phonology. Classification of speech sounds: vowels and consonants. Understanding syllables: mono- syllabic, di- syllabic and multi - syllabic words. Mastering stress and intonation patterns. This course is structured to provide students with essential English language skills necessary for academic success and professional communication in their respective disciplines.

IGB 121: Readings and Practice in Igbo (1 Unit C: LH 15)
Essay writing, Figures of speech, Traditional literature, Written literature, Translations and Dictionaries in Igbo, Test, Igbo indigenous knowledge, Speech writing, Comprehension, poetry or drama, Research in Igbo within the university, Using computer to write Igbo.

FRE 124: Elementary French II (1 Unit *E: LH 15)
LES VERBES ET LES ADVERBES FRANCAIS (FRENCH VERBS AND ADVERBS). CONSTRUCTION DES PHRASES FRANCAISES (FRENCH SENTENCE CONSTRUCTION). Introduction to essential verbs (être, avoir, aller, aimer). Present tense conjugation and sentence construction. Sentence Formation and Communication. EXPRIMER LES ACTIVITES QUOTIDIEN (DAILY ACTIVITY EXPRESSIONS. -Sentence Formation and Communication. Using adjectives, pronouns, and common expressions. Everyday vocabulary and basic sentence structures. Engaging in basic conversations and describing daily activities. LES ADJECTIFS POSSESSIFS (POSSESSIVE ADJECTIVES).

GER 125: Elementary German II (1 Unit *E: LH 15)
Verbs – Modal, Separable and Inseparable. Modal verbs and their applications. Separable and inseparable verb prefixes. Family, Professions and Descriptive Adjectives. Vocabulary for family structures. Identifying professions and their gender forms. Adjective declension and sentence construction. The Human Body, Colors and Opposites. Naming body parts and their functions. Understanding and using colors in different contexts. Common antonyms and contrasting words.

GET 211: Applied Electricity I (3 Units C: LH 30, PH 45)
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 212: Engineering Graphics and Solid Modeling II (2 Units C: LH 15; PH 45)
Projection of lines, auxiliary views and mixed projection. Preparation of detailed working production drawing; semi-detailed drawings, conventional presentation methods. Solid, surface and shell modeling. Faces, bodies and surface intersections. Component-based design. Component assembly and motion constraints. Constrained motions and animation. Introduction to electronics modeling. Electronics board layout preparation, Component libraries and Schematic design. Parametric modeling and adaptive design. Simulation for material optimization. Designing for manufacturing. Additive and subtractive manufacturing. Production for 3-D printing, Laser cutting and CNC machinery. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant).

GET 213: Engineering Mathematics I (3 Units C: LH 45)
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 214: Applied Mechanics (3 Units C: LH 45)
Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyze

GET 215: Students Workshop Practice (2 Units C: LH 15; PH 45)

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 216: Fundamentals of Thermodynamics (3 Units C: LH 45)

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.

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

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

GST 217: Philosophy, Logic and Human Existence (2 Units C: LH 30)

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.

MCE 221: Algorithm and Data Structures (2 Units C: LH 30)

Algorithms and data structures in a programming language (e.g., Python, Java, C++). Selection and implementation of the most appropriate data structures and algorithms to solve given problems efficiently. Debug, optimize, and analyze solutions for correctness and efficiency.
Searching algorithms (e.g., binary search); Sorting algorithms (e.g., quicksort, mergesort); Graph traversal techniques (e.g., BFS, DFS); Tree operations (e.g., insertion, deletion, traversal); Advanced structures like hash tables, heaps, and tries. Application of algorithms for: Shortest paths (e.g., Dijkstra's, Bellman-Ford); Minimum spanning trees (e.g., Prim's, Kruskal's); Network flow and connectivity problems.

GET 221: Computing and Software Engineering (3 Units C: LH 30; PH 45)

Introduction to computers and computing; computer organization – 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 222: Engineering Materials (3 Units C: LH 45)

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 aluminum (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 crystallization, polymer degradation and aging. Thermoplastic and thermosetting polymers and concepts of copolymers and homopolymers. Composites; definition, classification, characterization, 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 223: Engineering Mathematics II (3 Units C: LH 45)
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 224: Strength of Materials (3 Units C: LH 45)
Consideration of equilibrium; composite members, stress-strain relation. Generalized 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 225: Fundamentals of Fluid Mechanics (3 Units C: LH 45)
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 226: Electrical and Electronics Engineering Laboratory (1 Unit C: PH 45)
Resistance measurement; Condition for maximum power transfer; inductance and capacitance measurement; verification of network theorems; ac series circuits. Measurement of power and power factor, excitation of dc generator, load characteristics of a separately excited dc motor; open and short circuit tests for a transformer. Static characteristics of junction diode and transistor, Half and full wave rectification, determination of copper temperature coefficient by Wheatstone bridge, measurement of voltage, current, and power in three phase star/delta connection, simple domestic installation practices.

GET 227: Engineering Laboratory II (1 Unit C: PH 45)
Crystal structure of selected specimen (BCC, FCC, HCP). Crystal imperfection. Determination of solidification curve of selected metals. Heat treatment processes (annealing, normalizing). Heat treatment processes hardening and tempering. Microstructural examination of mild steel. Commination devices. Pneumatic conveying system for solids. Use of cyclone to separate solids from air stream. Introduction to different types of screening equipment. Determination of the thermal conductivity of a metallic rod. Determination of the thermal conductivity of an insulating powder. Determination of the thermal conductivity of a solid by the guarded hot plate method. Verification of the Stefen-Boltzmann constant for thermal conductivity. Mechanical test: Impact test, Tensile test, Hardness test, Fatigue test, Creep and Non-destructive test of engineering materials, testing of magnetic materials e.g. transformer cores, testing of insulators, cables and transformers coil and verification of P-N junction characteristics. Tensile tests on bars. Determination of young's modulus of rigidity of materials of close coiled helical spring and stiffness of spring. Radiation resistant spring. Proximate analysis and determination of the calorific value of coal and coke using Bomb Calorimeter. Composite materials, corrosion testing, entropy change during reversible and irreversible processes using heat exchanger.

GET 229: Students Industrial Work Experience I (3 Units C: PH 135)
Practical experience in a workshop or industrial production facility, construction site or special centers in the university environment, considered suitable for relevant practical/industrial working experience but not necessarily limited to the student's major. The students are exposed to hands-on activities on workshop safety and ethics, maintenance of tools, equipment and machines, welding, fabrication and foundry equipment, production of simple devices; electrical circuits, wiring and installation, etc. (8-10 weeks during the long vacation following 200 level).

MCE 311: Design of Mechatronics and Robotics Systems I (2 Units C: LH 30)
Integrated design process of mechatronics systems; components of mechatronics systems, sensors and actuators, fundamental principal of operation for components, strengths and weaknesses, and operational characteristics. The design process; integrated iterative design, sub-systems, component selection and sizing, design considerations, state-of-the-arts and challenges. Design exercises with increasing degrees of complexity. Others are mechatronics design concepts: integrative design, concepts analogies between electrical and mechanical systems, appreciation of components of mechatronics systems, formulation of design requirements, design exercise and justifications, optimal division into sub systems component, selection and sizing prototype development, appraisal of benefit and cost evolution of mechatronics design and challenges. case studies.

MCE 312: Electronic Circuits and Devices for Robotics I (1 Unit C: LH 15)
Single-stage transistor amplifiers using BJT and FET Equivalent circuits and calculation of current gain, voltage gain, power gain, input and output impedance. Operational Amplifiers: Description, parameters and applications. Feedback, broadband and narrowband amplifiers. Power amplifiers. Voltage and current stabilizing circuits. Voltage amplifiers, multi storage amplifiers using BJTs and FETs.

MCE 313: Mechanisms and Motion Systems (2 Units C: LH 30)
Multi-Degree-of-Freedom Mechanisms. Cams and Followers: Types of cams, follower motion, pressure angle, cam profile synthesis. Gear Systems and Trains: Spur gears, gear trains, velocity ratio, interference, compound gear trains. Friction and Brakes in Mechanisms: Belt and rope drives, clutches, brakes, friction in machine elements. Flywheels and Governors: Energy fluctuation, turning moment diagram, speed regulation, centrifugal governors. Vibrations in Mechanical Systems: Free and forced vibration, damping, resonance, vibration control. Synthesis of Mechanisms: Path generation, motion generation, coupler curves, design procedures. Applications in Mechatronic Systems: Integration of mechanisms with actuators and sensors, motion control basics.

GET 311: Engineering Statistics and Data Analytics (3 Units C: LH 45)
Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles. Probability. Binomial, Poisson hyper-geometric, normal distributions. Statistical inference intervals, test hypothesis and significance. Regression and correlation. Introduction to big data analytics and cloud computing applications. Introduction to the R language; R as a calculator; Vectors, matrices, factors, data frames and other R collections. Iteration and looping control structures. Conditionals and other controls. Designing, using and extending functions. The Apply Family. Statistical modelling and inference in R.

GET 312: Introduction to Artificial Intelligence, Machine Learning and Convergent Technologies (3 Units C: LH 45)

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

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

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

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

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

market/customer solution, customer solution and emerging technologies, business applications of new technologies - artificial intelligence (AI), virtual/mixed reality (VR), Internet of things (IoTs), blockchain, cloud computing, renewable energy, etc. Digital business and e-commerce strategies).

GET 313: Engineering Mathematics III (3 Units C: LH 45)

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

GET 314: Engineering Laboratory III (1 Unit C: PH 45)

Introduction to IoT, AI, and Data Analytics: Concepts and Trends. IoT Architecture and Protocols (MQTT, HTTP, CoAP). Sensors, Actuators, and Embedded Platforms (Arduino, ESP32, Raspberry Pi). Data Acquisition, Signal Conditioning, and Streaming. Cloud and Edge Computing for IoT. Introduction to Machine Learning: Concepts and Tools (Python, Scikit-learn). Supervised Learning: Regression and Classification on IoT Data. Unsupervised Learning: Clustering, Anomaly Detection. Real-Time Analytics and Dashboarding (Node-RED, Grafana, Power BI). AI at the Edge: TinyML, TensorFlow Lite, Model Deployment on Microcontrollers. Case Studies: Smart Homes, Healthcare, Predictive Maintenance. IoT Security, Data Privacy, and Ethical Considerations. Project Planning and System Design. Final Project Development and Testing. Final Project Presentation and Demonstration.

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

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

GST 312: Peace and Conflict Resolution (2 Units C: LH 30)
The concepts of peace, conflict and security in a multi-ethnic nation. Types and theories of conflicts: ethnic, religious, economic, geo-political Conflicts; structural conflict theory, realist theory of conflict, frustration-aggression conflict theory; root causes of conflict and violence in Africa: indigene and settlers phenomenon, boundaries/boarder disputes, political disputes, ethnic disputes and rivalries, economic inequalities, social disputes, nationalist movements and agitations; selected conflict case studies – Tiv-Junkun, ZangoKartaf, chieftaincy and land disputes, etc. Peace building, management of conflicts and security: Peace & Human Development. Approaches to Peace & Conflict Management (religious, government, community leaders). Elements of peace studies and conflict resolution: Conflict dynamics assessment Scales: Constructive & Destructive. Justice and Legal framework: Concepts of Social Justice; The Nigeria Legal System. Insurgency and terrorism. Peace mediation and peace keeping. Peace and Security Council (international, national and local levels). Agents of conflict resolution – Conventions, Treaties Community Policing: Evolution and Imperatives. Alternative Dispute Resolution (ADR) (dialogue, arbitration, negotiation, collaboration, etc). The roles of international organizations in conflict resolution ((a) The United Nations, UN and its conflict resolution organs. (b) The African Union & Peace Security Council (c) ECOWAS in peace keeping). The media and traditional institutions in peace building. Managing post-conflict situations/crises: Refugees. Internally Displaced Persons (IDPs); the role of NGOs in post-conflict situations/crises.

MCE 321: Commercial Technology Development (2 Units C: LH 15 PH: 45)
History of machining and machine tools. Lathes, drill press, millers and grinders. Turning and boring, drilling, reaming, milling, planning, shaping and grinding processes. Slotting and broaching, honing and lapping, gear cutting, cutting tool, cutting forces, cutting tool geometry, tool failure and tool wear mechanisms, cutting fluid and surface finishing. Determination of spindle speeds and feed speeds, chippless material removal processes. Introduction of automation in manufacturing visualization fixtures. Machine tool installation, testing and maintenance. Workshop practical based on topics covered.

MCE 322: Computer Integrated Manufacturing (2 Units C: LH 15 PH 45)
Review of drawing using AUTOCAD (2D and 3D). Design/simulation with solid graphics and other advanced graphics in engineering. Computer Integrated Manufacturing (CIM) system. Introduction to Computer Numerical Control (CNC) Machine tools and programming. Introduction to Control Systems. Counters, Registers, Computer Memories, and microprocessor. Programmable Logic Devices. Programmable Logic Control. Mechatronics; microcontroller programming interfacing and applications in classical control concepts and mechatronics system design. Robotics and their applications; Types, locomotion, kinematics, dynamics and control of robots. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components. Programming and Simulation of machining using the following features: Linear and Circular interpolation; Pocket milling, slotting, peck drilling and other fixed canned cycles. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.

MCE 323: PLC Fundamentals and Programming (2 Units C: LH 30)
Introduction to PLCs: Definition and Purpose of PLCs, Advantages of PLCs over Traditional Control Systems, Applications of PLCs in Various Industries. Components of a PLC System:

Central Processing Unit (CPU), Power Supply, Input/Output (I/O) Modules, Communication Interfaces, Programming Devices. PLC Hardware: Types of PLCs (Compact, Modular, Rack-Mounted), Digital and Analog I/O Modules, Sensors and Actuators, Wiring and Connection Basics, Understanding PLC Specifications. Basic PLC Programming Concepts: Introduction to Programming Languages (Ladder Logic, Function Block, Structured Text, etc.), PLC Scan Cycle (Input Scan, Program Execution, Output Scan), Addressing in PLCs (Inputs, Outputs, Memory Locations). Ladder Logic Programming: Symbols and Functions, Basic Logic Gates (AND, OR, NOT), Timers (On-Delay, Off-Delay, Retentive), Counters (Up, Down, Reset), Practical Examples: Start/Stop Circuits, Motor Control, Light Sequencing. Advanced PLC Programming: Arithmetic and Data Handling Instructions, Analog Input/Output Handling, Subroutines and Interrupts, Creating and Using User-Defined Functions, Troubleshooting and Debugging Programs. Human-Machine Interface (HMI) Basics, Introduction to HMI Devices, HMI-PLC Communication, Designing Simple HMI Screens, Interfacing HMI with PLC Programs. Communication and Networking, PLC Communication Protocols (Modbus, Ethernet/IP, Profinet, etc.), Introduction to Industrial Networks, Interfacing Multiple PLCs, Remote Monitoring and Control.

GET 321: Engineering Economics (3 Units C: LH 45)

The nature and scope of economics. Basic concepts of engineering economy- Relationship between Science, Engineering, Technology and Economics. Theories of Maximization-Profit Maximization, Growth Maximization, Sales Revenue Maximization, Utility Maximization and Wealth Maximization. Theory of Demand-Demand schedule, Nature and characteristics of demand, Law of demand, Limitations to the law of demand, Elasticity of Demand: Price, Income and Cross elasticity, Demand Forecasting definition, factors determining demand forecasting, methods of demand forecasting. Cost Concepts-Types of costs: Fixed cost, Variable cost, Average cost, Marginal cost, Real cost, Opportunity cost, Accounting and Economic cost, Cost - Volume profit analysis, Break - Even analysis, Operating leverage. Interest formulae, discounted cash flow, present worth, equivalent annual growth and rate of return comparisons. Replacement analysis. Benefit-cost analysis. Minimum acceptable rate of return. Acccounting Concepts-Double Entry system, Journal, Ledger, Trail balance, Final Accounts Book Keeping system, Depreciation - Definition, functions, methods of depreciation; Straight line, Declining balance; Sum of years digits method. Judging attractiveness of proposed investment.

GET 322: Technical Writing and Communication (3 Units C: LH 45)

A brief review of common pitfalls in writing. Principles of clear writing (punctuations and capitalization). Figures of speech. Units of grammar. Tenses and verb agreement. Active and passive sentences Lexis and structure Fog Index concept. Skills for communication and communication algorithm. Types and goals of communication; Interpersonal communication; features and the Finger Model or A,B,C,D,E of good interpersonal communication (accuracy of technical terms, brevity of expression, clarity of purpose, directness of focus and effectiveness of the report). Language and organization of reports. Technical report writing skills (steps, problems in writing, distinguishing technical and other reports, significance, format and styles of writing technical reports). Different formats for communication; styles of correspondences – business report and proposal, business letter, memorandum, e-mails, etc. Proposals for projects and research; format, major steps and tips of grant-oriented proposals. Research reports (competency, major steps, components and formats of research reports and publishable communication). Sources

and handling of data, tables, figures, equations and references in a report. Presentation skills; overview, tips, organization, use of visual aids and practicing of presentation. Intellectual property rights in research reports. Case studies of major engineering designs, proposals and industrial failures with professional presentation of reports.

GET 323: Engineering Mathematics IV (3 Units C: LH 45)

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

GET 324: Renewable Energy Systems and Technology (3 Units C: LH 30 PH 45)

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

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

GET 329: Students Industrial Work Experience II (4 Units C: PH 180)

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

Section A: Welding and fabrication processes, automobile repairs, · lathe machine operations: machining and turning of simple machine elements, such as screw threads, bolts, gears, etc.

Simple milling machine operations, machine tool maintenance and troubleshooting, and wooden furniture making processes.
Section B: Mechanical design with computer graphics and CAD modelling and drafting. Introduction to Solidworks: software capabilities, design methodologies and applications. Basics part modelling: sketching with SolidWorks, building 3D components, using extruded Bose base · Basic assembly modelling, and Solidworks drawing drafting. Top-down assembly technique exploded view, exploded line sketch. Introduction to PDMS 3D design software; AutoCAD mechanical, SPSS.
A comprehensive case study design project. The student should be introduced to the concept of product/component design and innovation and then be given a comprehensive design project.
Examples of projects should include the following:

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

MCE 411: Computer Vision and Image Processing (2 Units C: LH 30)

Computer vision and image processing are important and fast evolving areas of Mechatronics and Robotics. Student will get familiar with both established and emergent methods, algorithms and architectures. The course will enable students to apply computer vision and image processing techniques to solving various real-world mechatronics and robotics problems, and develop skills for research in the fields. Image formation, image filtering, edge detection and segmentation, morphological processing, registration, object recognition, object detection and tracking 3D vision. The topics may include but are not limited to:

1. Image formation and perception, image representation.
2. Image filtering: space- and frequency- domain filtering, linear and non-linear filters.
3. Morphological image processing.
4. Image geometric transformations, image registration.
5. Edge detection, image segmentation, active contours, and level set methods.
6. Object recognition, template matching, and classification.
7. Object detection and tracking: background modeling, kernel-based tracking, particle filters.
8. Camera models, stereo vision.

MCE 412: Microcontroller and Embedded Systems (2 Units C: LH 30)

Introduction to embedded systems, history, design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing, communication protocols like SPI, I2C, CAN etc. RISC Design Philosophy, comparison between CISC and RISC; PIC/AVR/ARM Design Philosophy; Embedded System hardware, Embedded System software. PIC/AVR/ARM Processor fundamentals –PIC/AVR/ARM core architecture, data flow model, Register, Current Program Status Register, Pipeline, Exceptions, Interrupts and Vector Table, Core Extensions, PIC/AVR/ARM Processor families. PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 processors Block diagram and pin diagram, operating modes: Study of on-chip peripherals like I/O ports, timers, counters, interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM and USB. Hardware interfacing

of PIC16F18877/ATmega328P/ATSAM3X8E Cortex-M3 using CCS C. Compiler/Flowcode/Embedded C language: LED, Switches, LCD Display & stepper motor. Onchip programming: UART, Timer, Real-Time Clock & ADC. Others include Architecture of kernel, task and task scheduler, ISR, Mutex, Semaphores, mailbox, message queues, pipes, events, timers, Priority inversion problem, priority Inheritance, RTOS services in contrast with traditional OS. Introduction to μcos II RTOS and its features, study of kernel structure of μcos II. Case study of digital camera and automatic chocolate vending machine (without codes).

MCE 413: Control Engineering (2 Units C: LH 15; PH 45)

Introduction to control system: Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function. Mathematical modeling of dynamic systems: Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring– Mass Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tach generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator. Time domain analysis: Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh Hurwitz criteria and applications. Error Analysis: Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants. Stability Analysis: Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. Frequency domain analysis of linear system: Bode plots, Polar plots, Nichol's chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichol's chart. circle and Contours in Nichols chart. Control System performance measures: Improvement of system performance through compensation. Lead, Lag and Lea lag compensation, PI, PD and PID control.

MCE 414: Industrial Automation and Control (2 Units C: PH 30)

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems Measurement Systems: Pressure and Force Measurement, Temperature measurement, Displacement and Speed Measurement, Flow Measurement, Measurement of Level, Humidity and pH, Signal Conditioning Circuits, Errors and Calibrations. Process Control: Introduction to Process Control, PID, PID Controller Tuning, PID Controller Implementation Programmable Logic Control: The Software Environment and Programming of PLC, Sequence Control and Structured RLL Programming, Programming of PLCs Sequential Function Chart. CNC Machines: Introduction to CNC Machines, CNC Machines Interpolation, Control and Drive. Actuators: Control Valves, Directional Control Valves, Switches and Gauges, Industrial Hydraulic Circuits, Pneumatic Control Components, Pneumatic Control Systems. Electric Machines Drive: Energy Savings with Variable Speed Drives, Step Motors - Principles, Construction and Drives, DC

Motors Drives, Induction Motor Drives, BLDC Motor Drives. Industrial Embedded and Communication System: Introduction to Real-time Embedded Systems, Real-Time Operating Systems, Networking of Field Devices via Fieldbus, Higher Levels of Industrial Automation.

MCE 415: Sensor and Actuators (2 Units C: LH 30)

This course provides an introduction to sensors and actuators in mechatronics systems. The topics include sensing principles for measuring motion, force, torque, pressure, flow, and temperature using analogue and digital transducers; actuating principles for continuous drive actuators and stepper motors; power transmission systems; and methods for signal collection, conditioning and analysis. Various components will be experimentally tested and analyzed. Others are basics of Energy Transformation: Transducers, Sensors and Actuators.

Understanding of Sensor Interfacing with Microprocessor to build electronic system Week Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor-based electronics systems. Sensor performance criteria and selection, including: (a) Thermocouples (b) Resistive sensors (c) Inductive sensors (d) Capacitive sensors (e) Piezoelectric sensors (f) Encoders and tachometers. Actuator performance criteria and selection, including: (a) Fluidic actuators (b) Solenoids and voice coil motors (c) Stepper motors (d) DC motors (e) Piezoelectric actuators (f) Shape memory alloy actuators (g) MEMS sensors and actuators. Merits of Fluid power & its utility for increasing productivity through Low-Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, Signaling & control system. Introduction to Industrial Hydraulics, Hydraulics Power System elements and standard symbolic Representation (CETOP symbols). Pneumatic & hydraulic control elements (control valves & hydraulic pumps, accessories), Basic circuits for controlling single & double-acting cylinder, Basic circuits, Advantages of Hydro Pneumatics and its applications, Hydraulics system and their Classification. Hydraulics circuits Hydraulic Motors, Hydraulic Fluids and effective contamination control. Advanced pneumatic circuits for controlling multi-cylinders (operable & inoperable circuits), Electro pneumatics with relay logic, Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

MCE 416: Instrumentation Engineering (3 Units C: LH 45)

History of metrology, Advancements in metrology, Gaging methods; Linear, angular, and diameter gaging. Standards and calibration. Non-contact gaging methods and measurement. In-line gaging and data collection, Unit conversions; English-Metric conversion and application, English-Metric Instrumentation, GD&T and inspection; Understanding datum and datum selection, Geometric characteristics and applications, Application modifiers, Interpretation and application of multiple datum control frames, Concepts of gage selection; Gage selection process considerations, Gage selection GD&T consideration, Gage selection part configuration, Inspection variables; Thermal impact on inspection, Material stability influence, Part configuration influence, case studies of quality assurance; Quality assurance and control failures, Concepts of non-contact inspection; Lasers, Optical comparators and vision systems, Industrial radiography, Non-destructive testing, Process interface to inspection; Process adjustment and compensation, In-line inspection, Elements of gaging care and calibration; Calibration and Adjustments, Cleaning and Maintenance, Repair and re-calibration, Elements of quality plans and metrology; Control plan for calibration, Identification and documentation, Traceability.

MCE 417: Electronic Circuits and Devices for Robotics II (2 Units C: LH 30)
Operational Amplifiers (Op-Amps): Ideal vs. practical Op-Amps. Op-Amp circuits, Inverting and non-inverting amplifiers, Integrators and differentiators. Voltage followers design and applications. Active filters (low-pass, high-pass, band-pass, and band-stop). Oscillators. Power Amplifiers: Classification of power amplifiers (Class A, B, AB, C). Efficiency and linearity considerations. Push-pull amplifiers. Heat dissipation and thermal management. Oscillators and Signal Generators: Oscillator principles, Barkhausen criterion, Types of oscillators: LC Oscillators (Colpitts, Hartley), RC Oscillators (Wien Bridge, Phase Shift), Crystal Oscillator. Multivibrators and Waveform Generators. Tuned Amplifiers, Principles of resonance. Quality factor (Q) and bandwidth. Noise in Electronic Circuits. Types of noise: Thermal, shot, flicker, and burst noise. Signal-to-noise ratio (SNR), Techniques to minimize noise in circuits. Circuit Simulation and Design Tools. Introduction to SPICE and other circuit simulation software. Practical design of circuits using simulation tools.

MCE 418: Fluid Power Systems (3 Units C: LH 45)
Unsteady flow; oscillation in U-tube; surge tank; water hammer. Open-channel flows. Introductory concepts of boundary layer and re-circulating flows, mathematical derivation of Navier-stokes equations and its application. Dimensional analysis and similitude. Introduction to turbo machinery; characteristic curve for axial-flow and centrifugal pumps, fans, blowers, impulse and reaction turbines. Pump selection and application. Pipeline systems (Series and Parallel). Open channel flow. Overview of computational fluid dynamics (CFD)

MCE 424: Mechatronics Laboratory II (2 Units C: PH 60)
Programming microcontrollers (e.g., Arduino, PIC, or STM32). Real-time control and decision-making. Communication protocols (UART, SPI, I2C). Interfacing sensors and actuators with embedded systems. Analog-to-Digital (ADC) and Digital-to-Analog (DAC) conversions. Data acquisition and monitoring. PID control design and tuning. Practical implementation of control algorithms. Design of Robotic arms and mobile robots, Path planning and obstacle avoidance. MATLAB/Simulink, LabVIEW. Data visualization and analysis

GET 421 Engineering Project I (2 Units: C; PH 90)
In the second semester of the 400-level students, preferably in groups, work from the university on the identified industry or organization to tackle industry complex engineering problems. Theoretical issues may be provided by the department faculty or industry experts. During the vacation, students will now work full time with the organization/industry on the project as part of the SIWES III. The students can also go beyond the department and engage in multidisciplinary undertakings. Literature survey, review of existing systems etc. must be achieved to a satisfactory extent.

GET 422: Engineering Valuation and Costing (2 Units: C; LH 30)
Objectives of valuation work/ valuer's primary duty and responsibility. Valuer's obligation to his or her client, to other valuers, and to the society. Valuation methods and practices. Valuation reports. Expert witnessing. Ethics in valuation. Valuation standards. Price, cost and value. Depreciation and obsolescence. Valuation terminology. Real asset valuation; personal asset valuation. Machinery and equipment valuation. Oil and gas facilities valuation. Mines and quarries valuation. Appraisal reporting and review.

GET 429: Students Industrial Work Experience III (4 Units C: PH 180)
On- the -job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the first semester at 400-Level to the beginning of the first semester of the following session. Thus, the second semester at 400-Level is spent in industry). Each student is expected to work in a programme related industry, research institute or regulatory agencies etc, for a period of 6 months under the guidance of an appropriate personnel in the establishment but supervised by an academic staff of the Department. On completion of the training, the student submits the completed Log book on the experience at the establishment., Also, there will be a comprehensive report covering the whole of the student's industrial training experiences (GET 229, GET 329 and GET 429), on which a seminar will be presented to the Department for overall assessment.

MCE 511: Design of Mechatronics and Robotics Systems II (2 Units C: PH 90)
This is essentially the practical implementation of the content of MCE 311, with students working independently and in focus groups. See content of MCE 311 for more details.

MCE 512: Signals and Systems (3 Units C: LH 45)
The Concepts of sampling, quantization and aliasing. Discrete time signals and systems, discrete convolution, Z transforms, Z plane poles and zeros. Discrete Fourier transforms. Fast Fourier Transform. Concept of digital filtering, types of digital filters and properties. Digital transfer functions. One dimensional recursive and non-recursive filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Computer techniques in filter synthesis. Realization of filters in hardware and software. Basic image processing concepts

MCE 513: Design of Machine Elements (3 Units C: LH 30 PH 45)
Design process, Theories of parts failure, Codes and standards, Design considerations, Factor of safety, Strength and stress considerations, Reliability, Economics, Safety and product liability, Statistical considerations, Ergonomics, safety and aesthetic considerations, steady and variable loading, Design of threaded fasteners and connections, Welded, brazed and bonded joints, Flexible mechanical elements: Belts, Flat and round belt drives, V-belts and Timing belts, Gearing: Force analysis on helical gears, Force analysis on worm gears, Bevel gearing (general), Bevel gear stresses and Worm gearing, Shafts, axles and spindles: Determination of shaft geometry, Static loading, Bending and torsion and Fatigue, Fatigue analysis, Stiffness considerations and Estimating reliability, Mechanical springs: Stresses in helical springs, Deflection of helical springs, Extension and compression springs and Spring materials, Bearings (Rolling contact bearings): Bearing type, Bearing life, Bearing survival, Reliability goal and Load cycle analysis, Lubrication and journal bearings: Types of lubrication, Viscosity, Petroff's law, Stable lubrication, Clearance, Pressure fed bearings, Heat balance and Thick film lubrication, Hydrodynamic theory, Design considerations, Temperature and viscosity considerations, Loads and materials, Bearing types, Thrust bearings and Boundary lubricated bearings.

MCE 514: Communication Engineering (3 Units C: LH 30 PH 45)
Modulation. Reasons for modulation. Types of modulation. Amplitude modulation systems: Comparison of AM systems, Methods of generating, and detecting AM, DBS, SSB signals. Frequency mixing and multiplying, frequency division multiplexing, applications of AM systems. Frequency modulation systems: Instantaneous frequency, frequency deviation, modulation index, Bessel coefficients, significant sideband criteria, bandwidth of a sinusoidally modulated FM

signal, power of an FM signal, narrowband FM, direct and indirect FM generation, various methods of FM demodulation, discriminator, phase-lock loop; limiter, preemphasis and de-emphasis, stereophonic FM broadcasting. FM broadcast band specification, block diagram of FM radio receiver, limiter and ratio detector, automatic frequency control, squelch circuit, FM mono and FM stereo receivers. AM broadcast band and specification. FM broadcast band and specification. Image frequency. FM mono and FM stereo receivers. TV broadcast band and specification. Signal format, transmitter and receiver block diagrams of Black and White TV, and Color TV. Plain old telephone system. Cellular systems: including GSM and IS-95 CDMA. Principles of IP - datagram networks and routing. Principles of ATM; QoS on IP; Voice over IP; GPRS and ADSL - hybrid voice/data network principles. Third generation mobile systems: WCDMA concepts, multi-user detection, antenna array techniques, MIMO, high speed packet access, long term evolution, radio resource management, packet scheduling, core network evolution. Multimedia: image and video representation and transmission. Competing technologies: WiFi, WiMAX, FttX. Emerging techniques: may include MANET, cognitive radio.

MCE 515: Rapid Prototyping (3 Units C: LH 30 PH 45)

Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing. Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing. Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three-Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS). Materials for rapid prototyping systems: Nature of material – type of material – polymers, metals, ceramics and composites- liquid based materials, photo polymer development – solid based materials, powder-based materials - case study. Reverse engineering and new technologies: Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

GET 511: Engineering Project Management (3 Units C: LH 45)

Project management fundamentals – definitions, project environment, nature and characteristics, development practice, management by objectives, and the centrality of engineering to projects, infrastructures, national and global development. The scope of project management – organizational, financial, planning and control, personnel management, labour and public relations, wages and salary administration and resource management. Identification of project stakeholders; beneficiaries and impacted persons – functions, roles, responsibilities. Project community relations, communication and change management. Project planning, control and timeliness; decision making, forecasting, scheduling, work breakdown structure (WBS), deliverables and timelines, logical frameworks (log frames), risk analysis, role of subject matter

experts (SMEs), role conflicts; Gantt Chart, CPM and PERT. Optimization, linear programming as an aid to decision making, transport and materials handling. Monitoring and Evaluation – key performance indices (KPIs); methods of economic and technical evaluation. Industrial psychology, ergonomics/human factors and environmental impact considerations in engineering project design and management. Project business case - financial, technical and sustainability considerations. Case studies, site visits and invited industry professional seminars. General principles of management and appraisal techniques. Breakthrough and control management theory; production and maintenance management. Training and manpower development. The manager and policy formulation, objective setting, planning, organizing and controlling, motivation and appraisal of results.

GET 512: Engineering Law (2 Units C: LH 30)

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

MCE 521: Quality Control Methods for Product Reliability and Safety (3 Units C: LH 45)

Review of International quality standards. Proactive and reactive quality assurance and control techniques; emphasis on quality planning, statistical process control, acceptance sampling and total quality management; continuous improvement, statistical process control, leadership, and training. Issues in reliability and maintainability engineering. Study and application of statistical models and methods for defining, measuring and evaluating reliability of products, processes and services: life distributions, reliability functions, reliability configurations, reliability estimation, parametric reliability models, accelerated life testing, reliability improvement.

MCE 522: Micro-Fabrication Technology (2 Units E: LH 15 PH 45)

Silicon Integrated Circuit Fabrication Techniques: Processing Overview; Silicon; Layer Formation; Lithography & Patterning; Etching Techniques; Back-end Processing; Test Structures. MEMS/Microsystems Fabrication Techniques: MEMS Process Integration; 3-D Structure Fabrication; Wafer Bonding; Integrating MEMS with CMOS; Metrology Techniques; MEMS Device Examples.

MCE 523: Computer Hardware Engineering (2 Units E: LH 15 PH 45)

Digital logic. Data representation. Digital components and signals. Combinational and sequential logic design and realization. Microprocessor system design and programming. Simple and complex programmable logic devices. Hardware description languages and introduction to VHDL. CPU design and field programmable gate arrays (FPGAs). Elements of digital computer design; control unit, micro-programming, bus organization and addressing schemes. Micro-processors, system architecture, bus control, instruction execution and addressing modes. Machine codes,

assembly language and high-level language programming, Micro-processors as state machines. Microprocessor interfacing: Input/Output. Techniques, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters. System development tools: simulators, EPROM programming, assemblers and loaders, overview of available microprocessor application.

MCE 524: Power Electronics and Drive Systems (2 Units E: LH 15 PH 45)

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit. 2-pulse, 3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance— Gate Circuit Schemes for Phase Control–Dual converters. Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated, Load commutated, Switched mode regulators- Buck, boost, buck- boost converter, Introduction to Resonant Converters. Single phase and three phase voltage source inverters (both120^0modeand180^0mode)–Voltage& harmonic control--PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Introduction to space vector modulation –Current source inverter. Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control -single phase and three phase cyclo converters – Introduction to Matrix converters.

MCE 525: Mobile Robotics (2 Units E: LH 15 PH 45)

Introduction to Mobile Robotics: Definition and Importance of Mobile Robotics, Applications of Mobile Robots, Overview of Autonomous Systems. Types of Mobile Robots: Wheeled, Legged, Aerial, Underwater, etc. Robot Locomotion: Kinematics of Wheeled Robots, Types of Wheels and Configurations, Stability and Maneuverability, Legged Locomotion Basics. Robot Perception-Sensors for Mobile Robots: Proximity Sensors (Ultrasonic, Infrared), Vision Sensors (Cameras, LIDAR), Motion Sensors (IMU, Encoders). Sensor Fusion Techniques-Environment Representation: Grid Maps, Occupancy Maps. Localization- Problem of Localization in Robotics, Probabilistic Localization: Bayes Filter, Markov Localization, Monte Carlo Localization, Global vs. Local Localization. Mapping- Environment Mapping Techniques, SLAM (Simultaneous Localization and Mapping): Basics and Challenges, Feature-based and Grid-based SLAM, Visual SLAM. Robot Motion Planning- Path Planning Algorithms: Dijkstra's Algorithm, A* Algorithm, RRT (Rapidly-exploring Random Trees), Obstacle Avoidance Techniques, Navigation in Dynamic Environments. Control of Mobile Robots: Open-loop vs. Closed-loop Control, PID Control, Kinematic and Dynamic Control Models, Feedback-based Motion Control. Multi-Robot Systems; Coordination in Multi-Robot Systems, Swarm Robotics Concepts, Communication and Collaboration. Machine Learning in Mobile Robotics- Supervised vs. Reinforcement Learning in Robotics, Applications of Deep Learning for Perception, Policy Optimization for Motion and Control. Practical Implementation: Mobile Robot Platforms (e.g., TurtleBot, ROS, Lego Mindstorms), Simulation Tools (e.g., Gazebo, V-REP, Webots), Hands-on Projects: Navigation and SLAM Implementation. Ethical Considerations in Autonomous Systems, Safety and Privacy Concerns, Impact of Robotics on Society. Case Studies and Future Directions, Recent Advances in Mobile Robotics, Case Studies of Real-world Implementations, Open Research Challenges.

GET 521: Engineering Management (3 Units C: LH 45)

Essence of management task. Patterns of leadership. Creating a viable organization. Productivity and motivation, organizing task. The span of control and the delegation of authority. Organizational theory and concepts. Industrial safety. Industrial relations. Technology innovation and sustainability: Change, Risk, Logistic and Supply Chain management. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction and quality improvement by facility and process redesign and systems integration. Operational specialties integration in a project consulting firm. Group technology tasks involve designing, planning and implementing an engineering project to stimulate students' multidisciplinary teams' working ability or application of industrial engineering tools in evaluating and solving any practical organizational problem.

MCE 590: B.Eng. Project (6 Units C: PH 270)

Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars. This course lasts for one academic session.