Department of Chemical Engineering
Enugu State University of Science and Technology, Agbani, Enugu State, Nigeria

This document presents: ESUT's Vision, Mission and Objectives; Criterion 1- Programme Educational Objectives (PEOs); Criterion 2- Chemical Engineering Program Outcomes (POs); Criterion 3- Course Learning Outcomes (CLOs); and Criterion 4- Curriculum and Learning Process.

ESUT's Vision, Mission and Objectives

Vision: To be premier university in Africa in capacity development that promotes services to the society through quality teaching, research and community service.

Mission: To promote scholarship, especially in the areas of Science, Management and Technology, thereby ensuring the development of quality manpower that will utilize technology for the service of society.

The Objectives of Enugu State University of Science and Technology

The following objectives are expected to shape the direction of the University's academic development and orientation:

O1: To encourage the advancement of all branches of learning and to avail to all persons without
distinction an opportunity of acquiring higher education;

O2: To develop and offer academic and professional programmes leading to the award of degrees, diplomas, certificates and other distinctions to persons who attain the standards prescribed by the University and have in all respects satisfied the conditions and requirements laid down or otherwise approved by the University.

O3: To encourage and promote scholarship and to conduct research in scientific, technological,
professional and other aspects of life;

O4: To relate its activities to the technological, cultural, social and economic needs of the people
of Nigeria;

O5: To undertake any other activities appropriate to a University of the highest standard and such other activities as the University may decide in the furtherance of advancement of learning
particularly the sciences, engineering and technology;

O6: To promote research and development directed towards the production of goods and the improvement of technological services;

O7: To disseminate scientific and technological knowledge among scientists, researchers, industries, trade services and other bodies which may benefit from such knowledge;

O8: To promote the growth and development of scientific and technological applications in the
national economy through association with outside persons or bodies and through centers specially set up by the University in that behalf;

O9: To ensure that the subjects taught are oriented towards the immediate and long term needs
of the country and that such subjects are also relevant to the needs of the Nigerian economy;

O10: To establish industrial centres in order to promote the acquisition of industrial expertise and the exchange of skills between the University and industry.

CRITERION 1- PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

Well-defined and published Programme Educational Objectives

The Chemical Engineering Programme Educational Objectives (PEOs) describe the expectations of our graduates after a few years of work experience by contributing to the society through modern technologies and practices. It aims to enable suitably qualified graduates from a range of engineering backgrounds to:

PEO1 - Develop knowledge, skills (including transferable skills, such as leadership, motivation, time management, prioritisation, delegation, listening, communication, analytics) and understanding, as well as awareness and "know how", in the fields of engineering and its related disciplines so that as graduates they will be equipped to enter into self-employment and employment as professional engineers progressing on to Registered Engineer (or equivalent status) or a wide range of other professional careers.

PEO2 - Prepare them to engage in life-long and critical enquiry with skills in research and knowledge acquisition and an appreciation of the value of education to the wider community.

PEO3 - Provide them with internationally recognised qualifications which meet and exceed the requirements of the COREN Outcome-Based Education Benchmark for Engineering Programmes in Nigeria and international Benchmark Statements for Engineering for ABET, Engineering Council, UK, etc.

PEO4 - Provide the engineering industry and profession in Nigeria and elsewhere, with ready employable and enterprising graduates prepared for the assumption of technical, managerial and financial responsibilities.

PEO5 - Achieve the above in the contexts of the ESUT University Vision business plans, following the University's policies and procedures and conforming to the relevant sections of the Quality and Academic Standards (QAS) guidelines.

Criterion 2- Chemical Engineering Program Outcomes
Department of Chemical Engineering Program Outcomes (POs)

S/No.	Outcome
PO1	At the end of the Program, a student shall be able to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	At the end of the Program, a student shall be able to identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	At the end of the Program, a student shall be able to design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	At the end of the Program, a student shall be able to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	At the end of the Program, a student shall be able to 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.
PO6	At the end of the Program, a student shall be able to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	At the end of the Program, a student shall be able to understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	At the end of the Program, a student shall be able to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	At the end of the Program, a student shall be able to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	At the end of the Program, a student shall be able to 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, and give and receive clear instructions.
PO11	At the end of the Program, a student shall be able to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	At the end of the Program, a student shall be able to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Criterion 3- COURSE LEARNING OUTCOMES (CLOs)

Course Learning Outcomes for all levels
100 Level Courses

No.	**Course Learning Outcome – GST 111 – Communication in English I**
CLO1	Apply effective communication and writing skills on simple engineering activities
CLO2	Apply essay writing skills (organization and logical presentation of idea, grammar and style)
CLO3	Demonstrate the application of comprehension, sentence construction, outlines and paragraphs

No.	**Course Learning Outcome – GST 121 – Use of Library, Study Skills and ICT**
CLO1	Discuss in brief the history of libraries, library and education
CLO2	Acquaint with university libraries and other types of libraries, study skills (reference services)
CLO3	Identify the types of library materials, using library resource including e-learning, e-materials, etc.,
CLO4	Understanding library catalogues (card, OPAC, etc.) and classification, copyright and its implications
CLO5	Apply database resources, bibliographic citations and referencing
CLO6	Introduction to development of modern ICT, Hardware technology, Software technology, input devices, storage devices, output devices, communication and internet services, word processing skills (e.g., typing etc.)

No.	**Course Learning Outcome – GST 112 – Communication in English II**
CLO1	Introduction to logical presentation of papers, phonetics, instruction on lexis
CLO2	Apply the art of public speaking and oral communication, figures of speech and précis
CLO3	Using report writing

No.	**Course Learning Outcome – GST 118 – Peace and Conflict Resolution**
CLO1	Describe basic concepts in peace studies and conflict resolution, peace as vehicle of unity and development
CLO2	Illustrate conflict issues, types of conflict e.g., Ethnic/Religious/political/economic conflicts, the root causes of conflict and violence in Africa
CLO3	Identify and use the indigene/settler phenomenon, peace-building, management of conflict and security
CLO4	Application of elements of peace studies and conflict resolution, developing a culture of peace, peace mediation and peace-keeping
CLO5	Demonstrate the application of Alternative Dispute Resolution (ADR), dialogue/arbitration in conflict resolution
CLO6	Study the role of international organizations in conflict resolution e.g., ECOWAS, Africa Union, United Nations, etc.

No.	**Course Learning Outcome – MEC 122 – Basic Engineering Drawing**
CLO1	Introduction to Engineering Drawing as a means of communication
CLO2	Apply the Engineering drawing format, use of drawing instruments
CLO3	Identify the types of lines and their uses in Engineering drawing
CLO4	Demonstrate the application of circles and tangent, circles to satisfy conditions involving other circles, lines and points
CLO5	Identify and use the conic sections, and various methods of their construction
CLO6	Understand and apply the theory of projection, perspective (briefly), parallel projections (oblique general, cavalier, cabinet)

No.	**Course Learning Outcome – ICH 111 – General Chemistry I**
CLO1	Describe atoms, molecules and chemical reactions
CLO2	Illustrate the modern electronics theory of atoms to solve problems
CLO3	Identify and use the electronic configuration, periodicity and building up of the periodic table
CLO4	application of hybridization and shapes of simple molecules, valence forces and structure of solid
CLO5	Apply the chemical equations and stoichiometry, chemical bonding and intermolecular forces, kinetic theory of matter
CLO6	Demonstrate the application of Elementary thermo chemistry, rates of reaction, equilibrium and thermodynamics
CLO7	Study the properties of gases, redox reactions and introduction to electrochemistry, radioactivity

No.	**Course Learning Outcome – ICH 112 – General Chemistry II**
CLO1	History survey of the development and importance of organic chemistry
CLO2	Apply the electronic theory in organic chemistry, isolation and purification of organic compound
CLO3	Study the determination of structures of organic compounds including qualitative and quantitative analysis inorganic chemistry
CLO4	Describe the nomenclature and functional group classes of organic compounds
CLO5	Application to introductory reaction mechanism and kinetics, stereo chemistry
CLO6	Apply the chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkylamines, nitriles, aldehydes, ketones, carboxylic acids and derivative

No.	**Course Learning Outcome – ICH 197 – General Practical Chemistry I**
CLO1	Apply the laboratory experiments designed to reflect the topics taught in ICH 111 and ICH112 such as qualitative and quantitative chemical analysis, acid-base titrations
CLO2	Application of gravimetric analysis, calculation, data analysis and presentation
CLO3	Identify and use functional group analysis

No.	**Course Learning Outcome – ICH 198 – General Practical Chemistry II**
CLO1	Apply the continuation of laboratory experiments designed to reflect the topics taught in ICH 111 and ICH112, some of the experiments will have been carried out in ICH 117
CLO2	Application of gravimetric analysis, calculation, data analysis and presentation

No.	**Course Learning Outcome – MAT 111 – Elementary Mathematics I (Algebra and Trigonometry)**
CLO1	Introduction to elementary set theory, subsets, union, intersection, complements, Venn diagrams
CLO2	Apply real numbers, integers, rational and irrational numbers
CLO3	Applying mathematical induction, real sequences and series
CLO4	Introduction to theory of quadratic equations, binomial theorem, complex numbers, algebra of complex numbers the Argand diagram
CLO5	Identify and enlist Crystallization process, Reverse Osmosis, Humidification
CLO6	Demonstrate the application of De-Moire's theorem, in throats of unity, circular measures, trigonometric functions of angles of any magnitude, addition and factor formulae

No.	**Course Learning Outcome – MAT 112 – Elementary Mathematics II (Calculus)**
CLO1	Introduction and application of Trapezoidal and Simpon's rule
CLO2	Apply functions of a real variable, graphs, limits and idea of continuity
CLO3	Applying the derivative as limit of rate of change
CLO4	Identify and use techniques of differentiation, maxima and minima to solve Engineering problems
CLO5	Demonstrate the application of extreme curve sketching, integration, definite integrals, reduction formulae, application to areas, volumes (including approximate integration)

No.	**Course Learning Outcome – PHY 111 – General Physical I (Mechanics, Thermal Physics and Waves)**
CLO1	Introduction to the concept of space, time, units and dimension, kinematics, fundamental law of mechanics, statics and dynamics, work and energy, conservation laws
CLO2	Apply moments, energy of rotation, simple harmonic motion, motion of simple system, elasticity
CLO3	Application of Hooke's law, Young's shear and bulk moduli, Hydrostatics, pressure buoyane to solve problems
CLO4	Introduction to Archimedes' principles, surface tension, adhesion cohesion, capillarity, drops and Bubbles
CLO5	Use of temperature, heat, gas law, laws of thermodynamics, kinetic theory of gases, sound
CLO6	Demonstrate the application of the unified spectra analysis of waves, superposition of waves, propagation of sounding gases, solid and liquids and their properties
CLO7	Use the types of properties of waves as applied to sound and light energies

No.	**Course Learning Outcome – PHY 112 – General Physics II (Electricity, Magnetism and Modern Physics)**
CLO1	Introduction to Electrostatics, conductors and currents, dielectrics, magnetic fields and electro-magnetic induction
CLO2	Application of Maxwell's equations, electromagnetic oscillations and waves
CLO3	Applying Coulomb's law, methods of charging and ohm's law to solve problems
CLO4	Demonstrate the application of analysis of DC circuits, AC voltages applied to inductors, capacitors and resistance

No.	**Course Learning Outcome – PHY 197: General Practical Physics I**
CLO1	Introductory course emphasizes quantitative measurements, the treatment of measure errors and graphical analysis
CLO2	Carrying out experiments usingvariety of experimental techniques
CLO3	Study of the meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity etc.,
CLO4	This course is covered in PHY111 and PHY112, however, emphasis should be place on the basic physical techniques for observation, measurements, data collection, analysis and deduction

No.	**Course Learning Outcome – PHY 198 – General Practical Physics II**
CLO1	Continuation of the experiments designed for PHY111 and PHY112 some of which have been covered under PHY197

No.	**Course Learning Outcome – CEE 121 – Computer Programming**
CLO1	Introduction to computers and computing problems solving on computer algorithms, design using flowchart and pseudo-code
CLO2	Introduction to high level programming languages, Basic and FORTRAN syntax, flow of control, input/output constructs, data types
CLO3	Identify and use programming in FORTRAN
CLO4	Demonstrate an extensive exercises in using flowchart and pseudo-code to solve Engineering problems

No.	**Course Learning Outcome – MME 112 – Engineering Materials**
CLO1	Introduction to electronics configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure
CLO2	Apply the relationship between structure and properties of metals, alloys, ceremics and plastics
CLO3	Apply the principles of behaviour of materials in common environments
CLO4	Study the fabrication processes and its applications

200Level Courses

No.	**Course Learning Outcome – ENS 222 – Introduction to Entrepreneurship**
CLO1	Introductory entrepreneurial skills.
CLO2	Analyze the relevant concepts: Enterprise, entrepreneur, entrepreneurship, Business, Innovation, Creativity, Enterprising and entrepreneurial attitude and behavior.
CLO3	Describe the rationale for entrepreneurship, creativity and innovation for entrepreneurs and evaluate leadership and entrepreneurial skills for coping with challenges.
CLO4	Determining capital requirement and raising capital, financial planning and management, Legal issue, insurance and environmental consideration.
CLO5	Outline and explain extensively the unit operations and time management.
CLO6	Identify some overcoming job creation challenges which may arise, and evaluate opportunities for entrepreneurship,
CLO7	Identify the features of creativity and innovation for self-employment in Nigeria.
CLO8	Describe the forms of businesses, staffing, marketing and the new enterprise, feasibility studies and starting a new business.
CLO9	Explanation, done on the other side of the spectrum, are employability, skills-interview techniques, oral presentation skills, etc,

No.	**Course Learning Outcome – EEE 221 – Applied Electricity I**
CLO1	Identify the general application of electricity
CLO2	Analyze the fundamental concepts-electric field, charges and magnetic fields
CLO3	Explain the concept of Current B-H curves Kirchhoff's laws, superposition.
CLO4	Apply the concept of venin, Norton theorems, Reciprocity, RL, RC RLC circuit
CLO5	Demonstrate the concept and application of DC, AC bridges, Resistance, capacitance, inductance measurement, transducers, single phase circuits, complex J-notion, AC circuits, impedance, admittance, subscription.

No.	**Course Learning Outcome – EEE 222 – Applied Electricity II**
CLO1	Identify the fundamental concept of applied electricity
CLO2	Demonstrate the application of Basic machine – DC, synchronous alternators, transformers and equivalent circuits.
CLO3	Explain three phase balanced circuits, PN junction Diode, transistors, thyristors FRTs, Zener and Rectifiers.
CLO4	Apply the concept of Basic control systems, open/close loop systems.
CLO5	Identify the concept of Communications fundamentals, introduction of TV, Radio Telephone systems.

No.	**Course Learning Outcome – MEC 223 – Engineering Drawing I**
CLO1	Demonstrate general Revision of multi-view representation.
CLO2	Show harder examples on two and three view representation ($1^{st}$and 3^{rd} Angles).
CLO3	Show and engage in harder examples on isometric drawing to include simple pictorial assembly drawing in isometric.
CLO4	Demonstrate harder examples on oblique drawing (Cavalier, Cabinet and Angles other than 45 degrees).
CLO5	Explain the concept of Dimensioning, Sections and conventions Auxiliary views, Representation and specification of threads.
CLO6	Analyze and draw Bolted joints, Keys and cottered joints. Exposing Conventional representations

No.	**Course Learning Outcome – MEC 224 – Engineering Drawing II**
CLO1	Further works on projections;
CLO2	Demonstrate projection of points, lines, planes and solids.
CLO3	Explain and identify intersections of solids, Cams, Interpretation of solids and Development of surfaces.
CLO4	Describe the details in drawing belts, chains, gears, bearing and lubrication arrangements.
CLO5	Explain and demonstrate Couplings brake, flexible shafts, universal joints, etc.
CLO6	Describe assembly drawings and extensive revision

No.	**Course Learning Outcome – FEG 294 – Student Workshop Experience**
CLO1	Guide the student in the Introduction to practical and skills in general engineering and powered tools wood through instruction in operation of hand
CLO2	Explain and illustrate metal cutting and fabrication.
CLO3	Analyze the performances and experience in safe usage of tools and machines for selected tasks

No.	**Course Learning Outcome – CHE 225 – Fundamental of Fluid Mechanics**
CLO1	Explain the general concept of fluid and further identifying the properties of fluids,
CLO2	Demonstrate friction effects and losses in laminar and turbulent flows ducts and pipes.
CLO3	Analyze the concept of Dimensional analysis and dynamic similitude,
CLO4	Explain and illustrate fluids statics conservation laws
CLO5	Analyze the phenomena regarding principles of construction and operation of selected hydraulic machinery.
CLO6	Identify and use hydro power systems.

No.	**Course Learning Outcome – CEE 221 – Introduction to Modeling and Simulation**
CLO1	Explain the Introduction to computers and computing problems solving on computer algorithms, design using flowchart and pseudo-code
CLO2	Describe the generation knowledge to the Introduction to high level programming languages.
CLO3	Illustrate the phenomena of the following programming languages like Basic and FORTRAN syntax
CLO4	Show and explain the flow of control, input/output constructs and evaluates some data types
CLO5	Extensive exercises in solving engineering problems using flowchart and pseudo-code
CLO6	Engaging in thorough practical with regard to programming, (Programming in FORTRAN).

No.	**Course Learning Outcome – CHE 226 – Fundamental of Thermodynamics**
CLO1	Understand and Analyze the basic concepts of the quantitative relations of zeroth, first, second and third laws of thermodynamics.
CLO2	Identify and evaluate the behavior of pure substances and perfect gases.
CLO3	Explain the phenomena of ideal gas cycles
CLO4	Illustrate and use the above theories in solving engineering problems

No.	**Course Learning Outcome – CVE 227 – Applied Mechanics**
CLO1	Explain and illustrate the concept of Forces, moments and couples.
CLO2	Describe the phenomena of Newton's laws of motion
CLO3	Identify the features of kinetic energy and momentum analysis
CLO4	Explain kinematic of particles and rigid bodies in plane motion.
CLO5	Solving general engineering problems with respect to the above topics

No.	**Course Learning Outcome – CVE 228 – Strength of Materials**
CLO1	Recognise a structural system that is stable and in equilibrium
CLO2	Determine the stress-strain relation for single and composite members based on Hooke's law
CLO3	Estimate the stresses and strains in single and composite members due to temperature changes
CLO4	Evaluate the distribution of shear forces and bending moments in beams with distributed and concentrated loads
CLO5	Determine bending stresses and their use in identifying slopes and deflections in beams
CLO6	Use Mohr's circle to evaluate the normal and shear stresses in a multi-dimensional stress system and transformation of these stresses into strains
CLO7	Evaluate the stresses and strains due to torsion on circular members
CLO8	Determine the buckling loads of columns under various fixity conditions at the ends.

No.	**Course Learning Outcome – FEG 221 – Engineer in Society**
CLO1	differentiate between science, engineering and technology, and relate them to innovation
CLO2	distinguish between the different cadres of engineering – engineers, technologists, technicians and craftsmen and their respective roles and competencies
CLO3	identify and distinguish between the relevant professional bodies in engineering
CLO4	categorise the goals of global development or sustainable development goals (SDGs)
CLO5	identify and evaluate safety and risk in engineering practice

No.	**Course Learning Outcome – FEG 227 – Engineering Mathematics 1**
CLO1	Analyze the concepts of Limits and continuity
CLO2	Fully describe and illustrate the general concept of differentiation
CLO3	Explain the introduction to linear first order differential equations, partial and total derivatives
CLO4	Illustrate the application of composite functions, matrices and determinants,
CLO5	Solve more solutions involving vector algebra, vector calculus and directional derivatives.

No.	**Course Learning Outcome – FEG 228 – Engineering Mathematics II**
CLO1	Demonstrate and use second order differential equationsin solving engineering problems
CLO2	Identify and use line integral multiple integral and their applications
CLO3	Explain and apply differentiation of integral in solving engineering problems
CLO4	Analyze different phenomena associated with analytical functions of complex variables.
CLO5	Demonstrate the concept of Transformation and mapping and evaluate Special functions

No.	**Course Learning Outcome – FEG 293 – General Engineering Laboratory Course**
CLO1	Demonstrate and analyze laboratory investigation and report submission for selected experiments and projects in Thermodynamics, Applied Mechanics, Applied Electricity and Fundamental of fluid mechanics.

No.	**Course Learning Outcome – FEG 221 – Student Industrial Work Experience**
CLO1	Evaluate the experience gathered during IT which happens to take place from a chosen practical experience (this last for 8 weeks during the long vacation following 200 level)
CLO2	Analyze the performance of the students.

300Level Courses

No.	**Course Learning Outcome – ENS 311 – Engineering Practicum**
CLO1	Identify the profiles in business ventures for all business sectors involving production, training and sales to prepare and boost the engineering students in particular.
CLO2	Demonstrate the acts involve in the business initiatives in the production of house hold products like production of Soap/Detergent, Toothbrush and Toothpaste making, photography, Brick making, metal fabrication, Rope making, Brewing, Glassware production/ceramic production, paper production to equip the students in entrepreneurship.
CLO3	Further describe the production of agricultural and environmental products like water treatment/ conditioning/ packaging; food processing/preservation/packaging, vegetable oil extraction; farming; fisheries/aquaculture; plastic making; refrigeration/Air-conditioning; carving, weaving, carpentry, interior decoration, animal husbandry.
CLO4	Identify and analyze case study methodology applied to the development and administration of cases that bring out key issues of business environment, start up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses.
CLO5	Outline the experience sharing by business actors in the economy with students during case presentations as means of evaluating the student performance.
CLO6	Clearing observing the impacts of production in the business venture.

No.	**Course Learning Outcome – FEG 321 – Engineering Mathematics III**
CLO1	Identify and solve problems regarding Linear Algebra, Elements of matrices. Determinants, inverses of matrices theory of linear equations, eigen values and eigen vectors.
CLO2	Identify and use the concept of analytical geometry, coordinate transformation, solid geometry, polar, cylindrical and spherical coordinates, elements of functions of several variables, surface variables.
CLO3	Demonstrate the application of ordinary integrals, evaluation of double integrals, triple integrals, line integrals and surface integrals.
CLO4	Identify and apply the concept of vectors including derivation and integrals of vectors, The gradient of scalar quantities, flux of vectors, the curl of vectors, field, Gauss, Greens and Stroke's theorems.
CLO5	Demonstrate the application of the following functions; Singular values functions, Multi valued functions and analytical functions.
CLO6	Identify the concept of cauchy Riemann's singularities and Zeroes, Contour Integration including the use of cauchy's integral theorems, bilinear Transformation.

No.	**Course Learning Outcome – CHE 301 – Process Instrumentation**
CLO1	Identify and apply the concept of internal and physical properties
CLO2	Categorize measuring instruments for industrial applications and illustrate instrumentation for temperature, pressure, flow, level, composition and pH.
CLO3	Chemical composition analyzers.
CLO4	Identify the general concept of measurements and applications
CLO5	Illustrate the phenomena of Gas chromatograph and Mass Spectrometer also including its application
CLO6	Analyze the various sampling systems.

No.	**Course Learning Outcome – CHE 331 – Transfer Phenomena I (Heat Transfer)**
CLO1	Identify and distinguish various modes of heat transfer, examine the mechanisms involved and the associated governing laws. Evaluate mechanism of radiative heat transfer and analyze Heat exchange between radiating surfaces.
CLO2	Choose appropriate governing equations and analyze the different modes of heat transfer in different geometries and systems under steady and transient processes. Compare the different heat transfer processes based on the concept of analogy.
CLO3	Identify and explain the following concept; Unsteady state conduction. Free and forced convective heat transfer, Compressible flow, Normal shockwaves and Non-Newtonian fluids.
CLO4	Perform basic calculations to determine relevant design parameters for common heat exchangers and determination of heat transfer coefficients.
CLO5	Apply the concept of diffusion involving vapors, liquids and solids.
CLO6	Analyze the heat transfer associated with boiling and condensation and application to design of heat exchanges.

No.	**Course Learning Outcome – CHE 333 – Transfer Phenomena II (Mass Transfer)**
CLO1	Identify the concept of Boundary layer theory and turbulence.
CLO2	Identify and use the concept of Navier-Stokes equations
CLO3	Identify and apply the concept of Universal Velocity profile.
CLO4	Illustrate the phenomenon and application of Condensation and boiling.
CLO5	Explain and demonstrate the theories of mass transfer including mass transfer with chemical reaction
CLO6	Explain the phenomena of molecular diffusion, eddy diffusion and interphase mass transfer

No.	**Course Learning Outcome – CHE 335 – Particle Technology**
CLO1	Evaluate the particle size distribution, mean particle diameter, specific surface area and number of particles per unit mass using techniques such as sieve analysis, pipette analysis and beaker decantation
CLO2	Identify and analyze the properties of particles, evaluating the motion of particles in fluid and flow through packed beds. Explain the concept of stokes's and Newton's laws
CLO3	Demonstrate the application of screening and evaluate the classification and grinding with respect to particles.
CLO4	Select suitable size reduction equipment and estimate the energy requirements for a specified reduction in size for a given material.
CLO5	Describe separation techniques for particulates using different separation techniques
CLO6	Apply the concept of Fluidization, Sedimentation and flocculation, Filtration, Screening, Classification, grinding and applications.

No.	**Course Learning Outcome – CHE 341 – Chemical Engineering Thermodynamics I**
CLO1	Apply the concepts of Cycles, Carnot; thermodynamic Turbines Seamand Gas, Refrigeration; and evaluate general P-V-T Relations.
CLO2	Identify the P-V-T behaviour of pure substances, Equation of state for gasses, the principle of corresponding state, Compressibility relations, reduced pressure, reduce volume, temperature, and pseudo critical constants.
CLO3	Identify and use P-V-T approximations for gaseous mixture ideal gas mixtures. Dalton's law of additive pressure; Amagat's law of additive volumes; Pseudo critical point method; Kay's rule, Gilliland's method; Behaviour of liquids..
CLO4	Describe Heat Effects, Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clausius-Clapeyron equation, standard heats of reaction formation and combustion effect of temperature on heat reaction
CLO5	Explain the Heat of mixing and solution, Enthalpy concentration diagrams for H_2SO_4, H_20, etc., partial enthalpies, single and multiple effect evaporators with regards to heat effects.
CLO6	Analyze Thermodynamics of Flow Processes involving fundamental equations, continuity equation, equation of motion, energy equation, Bernoulli's equation, Flow in pipes, laminar and turbulent flows, Reynolds number, Fanning equation and friction factor.
CLO7	Demonstrate the application of Flow meter, Nozzles, Compressors single stage and multistage, and evaluating the effect of Clearance.

No.	**Course Learning Outcome – CHE 351 – Chemical Reaction Engineering**
CLO1	Analyze the mechanism of chemical reactions including measurement and analysis of weathering reaction.
CLO2	Determine the chemical kinetic parameters involving heterogeneous and catalytic reaction
CLO3	Identify and use ideal reactors for single, complex reactions and chain reactions.
CLO4	Develop skills to choose the right reactor for multiple reactions.
CLO5	indentify the phenomena of photochemistry and adsorption of gases on solids
CLO6	Analyze and illustrate the application of gas chromatography

No.	**Course Learning Outcome – CHE 361 – Introduction to Material & Energy Balance /Chemical process principles.**
CLO1	Understand the concept of 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 problem
CLO2	Demonstrate the application of chemical equation stoichiometry, material balances, Program of analysis of material balances, Program of analysis of material balances problem, problems with direct solutions, Material balances using algebraic techniques control surface and stage balances for open and closed system
CLO3	Describe the problems involving components (elements), Recycle, Bypass, Purge; Effect of recycle and purge on mass and energy balances.
CLO4	Apply the phenomena of Gases, vapours, liquid and solids and explain the following; Ideal gas law, Real gas relationships, Vapour pressure, Saturation, Partial saturation and humidity.
CLO5	Identify and use Material balanced involving condensation and vaporization phase phenomena, Energy balances, Concepts and Units, Heat capacity, Calculation of enthalpy changes without change phase, Enthalpy for phase transition in chemical process computation
CLO6	Demonstrate the concept of General Energy balance involving mechanical energy balance in Reversible processes
CLO7	Explain the concept of Heat of reaction, Heat of solution and mixing combine material and energy balances; Application of fundamental concept of mass and energy balances and mass transfer to unit operation in distillation an finally the Simultaneous use of material and energy balances for the steady state.
CLO8	Describe Complex problems; Lever rule Geometrical construction for mass and evaluate Energy balances for adiabatic and non-adiabatic process and also for Unsteady state material and energy balances.

No.	**Course Learning Outcome – CHE 391 – Chemical Engineering Laboratory I**
CLO1	Explain the concept of experiment and illustrate the steps involve in carrying of any experiment.
CLO2	Identify and apply procedures in writing experimental reports
CLO3	Demonstrate laboratory experiments in transport phenomena
CLO4	Illustrate laboratory experiments in Kinetics and separation process

No.	**Course Learning Outcome – FEG 322 – Engineering Mathematics IV**
CLO1	Use Mathematical tools in solving complex Engineering mathematical problems
CLO2	Employ simple approach in Solving Numerical integration, Laplace transformation, various level of differential equations.
CLO3	Explain and Calculate Sturm-Liouville Boundary value problems and Fouries Series Partial Differential Equation.
CLO4	discuss and Solve Linear, Homogenous and Partial differential equations of 9^{th} order with Constant Coefficients
CLO5	Explain and use different techniques in solving Integral Transforms

No.	**Course Learning Outcome – FEG 390 – Students Industrial Work Experience II (SIWES II)**
CLO1	Evaluate the experience gathered during IT which happens to take place from a chosen practical experience (this last for 12 weeks during the long vacation following 300 level)
CLO2	Analyze the performance of the students.

No.	**Course Learning Outcome – CHE 332 – Separation Process I**
CLO1	Identify and use of separation process in solving several engineering problems
CLO2	Demonstrate the application of Separation process generally in all chemical processand evaluating the process and type of equipment (Stage-wise and continuous contact equipment)
CLO3	Identify the concept of adsorption Isothermal gas absorption processes
CLO4	Apply the concept of Binary distillation, mechanisms involve and evaluating the analytical and graphical approaches.
CLO5	Illustrate the relevance of both hydrodynamics of packed and plate columns in distillation and adsorption processes
CLO6	Explain the concept of Leaching

No.	**Course Learning Outcome – CHE 362 – Chemical Reaction Engineering II**
CLO1	Identify different types of reactions
CLO2	Apply the concept of reaction in determining reaction rate and variables determining reaction rate
CLO3	Explain the phenomena in Arrhenius equations and evaluate Arrhenius rate expressions from postulated mechanisms
CLO4	Interpretation of batch reaction data, Integral and differential methods of analysis, Reversible, parallel, series, autocatalytic reactions in chemical reaction principles
CLO5	Demonstrate the optimization of output and yield from reactor and evaluate the comparison of various performances (PRR, CSIR, BR)
CLO6	Explain and analyze photochemistry

No.	**Course Learning Outcome – CHE 362 – Process Simulation And Statistics For Physical Science And Engineering**
CLO1	Understand the general concept of process simulation and focusing more on the use and application of HYSYS software or any other process simulation software
CLO2	Evaluate the performances of students in using the software in simulation processes
CLO3	Identify and explain the concept of probability, Binomial poison hyper-geometric and normal distribution for providing solutions to engineering problems
CLO4	Analyze and point out the application of statistical inference intervals tests hypothesis and significance.
CLO5	Analyze the concept of Regression and correlation in solving some Engineering problems
CLO6	Comparing the general statistical approach in engineering problems.

No.	**Course Learning Outcome – CHE 364 – Chemical Process Design And Evaluation I**
CLO1	Identify and analyze general design considerations and optimum design considerations
CLO2	Identify and describe different Sources of design information
CLO3	Identify and use the establishment of workable manufacturing processes, process conditions and facilities
CLO4	Apply the concept of Process design of mass transfer equipment
CLO5	Demonstrate the application of Evaluation techniques in design principles
CLO6	Describe patterns in development and presentation of design report.

No.	**Course Learning Outcome – CHE 380 – Polymer Process Engineering**
CLO1	Analyze and explain the concept of process including introduction, processing, and applications of organic polymeric materials.
CLO2	Explain the phenomena behind the chemistry of polymer manufacture
CLO3	Explain the concept of molecular structure of polymers
CLO4	Identify the several defects of polymers, causes and preventions to proffer engineering solution
CLO5	Identify the structure-property relationships for thermoplastic and thermosetting polymers are covered
CLO6	General application of the polymer products, their fabrication using some additives are further stress.

No.	**Course Learning Outcome – CHE 382 – Biochemical Engineering**
CLO1	Explain the concept regarding the Introduction to microbiology and biochemistry to further expose the foundational level to the engineering students.
CLO2	Analyze and demonstrate the classification and growth characteristics of micro-organisms in biochemical process.
CLO3	Explain the concept regarding enzymes in engineering.
CLO4	Apply the concept of Microbiolculture processes in manufacturing industries.
CLO5	Design several reactors used as bioreactors using material balance principles.
CLO6	General utilize the understanding of microbiology and biochemistry in engineering processes

No.	**Course Learning Outcome – CHE 392 – Chemical Engineering Laboratory II**
CLO1	Further bring back and explain the concept of experiment and illustrate the steps involve in carrying of any experiment.
CLO2	Identify and apply procedures in writing experimental reports
CLO3	Demonstrate laboratory experiments in transport phenomena
CLO4	Illustrate laboratory experiments in separation process and thermodynamics

400Level

No.	**Course Learning Outcome –CHE 414 – Separation Process II**
CLO1	Apply the concept of Stage-wise and Continuous contactors to solve engineering problems
CLO2	Apply the concept of Binary distillationto solve Engineering problems, understanding the process involved in Leaching, Packed and plate columns
CLO3	Identify and use the Drying of solids
CLO4	Describe the process of Multiple-effect evaporators
CLO5	Identify and enlist Crystallization process, Reverse Osmosis, Humidification
CLO6	Demonstrate the application of solvent extraction, Condensation process, Gas adsorption theorems

No.	**Course Learning Outcome – CHE 415 – Transport Phenomena III**
CLO1	Demonstrate the application of Boundary layer theory, Navier stokes equation to solve Engineering Problems
CLO2	Identify and use the Fick's law Gas diffusion, Maxwell's diffusion law to solve Engineering problems
CLO3	Understand the concept of Winkelman's two film theory
CLO4	Apply the Highie's penetration theory to solve Engineering problems
CLO5	Identify and use the Dankert's random surface renewal
CLO6	Demonstrate the application of Mass transfer coefficient process to solve Engineering problems

No.	**Course Learning Outcome – CHE 423 – Chemical Engr. Thermodynamics III**
CLO1	Understand and apply the Carnot cycle, thermodynamics cycle process to solve Engineering problems
CLO2	Apply the concept of Refrigeration and air conditioning cycle processes to solve Engineering problems
CLO3	Identify and use the Liquefaction processes, Nozzles, Compressors, ejectors
CLO4	Apply the Thermodynamics approach to solve fluid mechanics problems
CLO5	Identify and use the Thermodynamics of flow processes to solve Engineering problems
CLO6	Demonstrate the application of the Sonic velocity, Metering and Throttling processes
CLO7	Understand the concept of conservation of Mass and Energy in solving Engineering problems

No.	**Course Learning Outcome – CHE 442 – Chemical Process Dynamics and Control**
CLO1	Describe the concept of process dynamics, optimization and control
CLO2	Apply the concept of Automation, Dynamic analysis and Models-mass-spring system
CLO3	Identify and use the Electrical R-C circuits and analogue computers
CLO4	Apply the Laplace transformation process to solve fluid mechanics problems
CLO5	Identify and use the Response of first order systems, stability consideration and process control to solve problem
CLO6	Introduction to Multi-variable control and control valve

No.	**Course Learning Outcome – CHE 453 – Chemical Process Design and Evaluation II**
CLO1	Describe the concept of sourcing of design data, process charts and flow sheets
CLO2	Apply design selection, specification tools in the design of heat transfer equipment like double pipe heat exchanger, shell and tube heat exchanger and condenser
CLO3	Identify and use the Mechanical design of process vessels and piping tool to solve Engineering problems
CLO4	Apply the environmental consideration in solving design problems
CLO5	Illustrate by application of computer aided design and simulation using different softwares
CLO6	Construct detailed proportionate drawings of double pipe heat exchanger, shell and tube heat exchanger and condenser.

No.	**Course Learning Outcome – CHE 460 – Chemical Process Economics**
CLO1	Understand and apply the Types of investments, analysing the rate of return
CLO2	Apply the concept of other investment return techniques
CLO3	Identify and use the Cash flow analysis, present worth methods in choosing alternative investments
CLO4	Apply the Discount cash flow analysis, Breakeven analysis tools and evaluate the Production cost
CLO5	Identify and use the Replacement problems – buy and hire considerations to solve problems
CLO6	Evaluate the Economic of scale, risks and uncertainty on investments including sensitivity analysis

No.	**Course Learning Outcome – CHE 470 – Chemical Technology**
CLO1	Understand the concept of the Nigerian Chemical Industry
CLO2	Describe in details the concept of Chemical technology
CLO3	Identify and use the utilization of raw materials, coal, petroleum, natural gas, air, water, agricultural products and wastes
CLO4	Apply the concept of manufacturing hydrogen and synthesis gas
CLO5	Understand and apply the Catalytic reforming of hydrocarbons with stream process
CLO6	Identify and use ammonia, synthesis gas, nitrogenous fertilizers, ethylene

No.	**Course Learning Outcome – CHE 471 – Environmental Pollution and Control**
CLO1	Understand the Principal pollutants and their sources
CLO2	Apply the concept of other investment return techniques
CLO3	Understand Air pollution and technological sources of air pollution
CLO4	Evaluate the Principal pollutants emitted from combustion chambers, particulates, non-combustibles, and un-burn particles
CLO5	Identify particles formed during combustion gasses,
CLO6	Understand the Organic pollution combustion to solve environmental pollution

No.	**Course Learning Outcome – CHE 483 – Chemical Engineering Laboratory III**
CLO1	Apply laboratory experiments in transport phenomena
CLO2	Apply the concept of kinetics in laboratory experiments
CLO3	Application of separation process
No.	**Course Learning Outcome – FEG 490 – Students Industrial Work Experience III (SIWES III)**
CLO1	Introduction to the Industry
CLO2	Apply the theoretical knowledge in the Industrial pace
CLO3	acquire working experience and knowledge in the Industry
CLO4	improve Technical, Practical and experimental performance of the student

500Level Courses

No.	**Course Learning Outcome – CHE 501 – Loss Prevention in Process Industries**
CLO1	Understand and identify the hazards in chemical process industries
CLO2	Evaluate and apply of safety process like Hazop techniques in the plants
CLO3	Identify causes of accidents in process plants and evaluating the prevention measure to avoid accident from occurring or reoccurring.
CLO4	Apply optimization process and maintenance of plant to minimize losses
CLO5	Demonstrate the application of Pollution control measure
CLO6	Evaluate legal implications of various losses

No.	**Course Learning Outcome – CHE 539 – Separation Processes III**
CLO1	Understand the concept of humidification and water-cooling process to solve Engineering problem
CLO2	Describe and analyze the Solvent Extraction processes
CLO3	Identify and use the Extractive and azeotopic distillation process
CLO4	Apply the Multi-component gas absorption and distillation of multi-component mixtures principles
CLO5	Application of Novel distillation processes to solve Engineering problem
CLO6	Demonstrate the concept of Chromatography

No.	**Course Learning Outcome – CHE 554 – Chemical Reaction Engineering III**
CLO1	Introduction and application of applied catalysis, physical adsorption, and chemisorptions
CLO2	Application of adsorption isotherms to solve Engineering problems
CLO3	Use heat of adsorption, selectivity, catalyst preparation methods to solve problems
CLO4	Identify and use some criteria and test of catalyst performance
CLO5	Apply the characterization of the physiochemical properties of catalysts, texture and acidity of solid catalyst, deactivation of catalysts
CLO6	Analyze the kinetics and mechanisms of some industrial catalytic processes

No.	**Course Learning Outcome – CHE 502 – Chemical Process Optimization**
CLO1	Apply optimization techniques to formulate and solve practical problems
CLO2	Apply different numerical methods for optimization of single variable unconstrained functions
CLO3	Solve unconstrained multivariable optimization problems
CLO4	Solve linear programming and nonlinear programming problems with constraints using various Methods
CLO5	Analyze typical applications of optimization techniques in chemical process industries

No.	**Course Learning Outcome – CHE 567 – Chemical Plant Design**
CLO1	Generally, the concept of design is brought to light paying more emphasis on chemical process and plant design
CLO2	Identify problems involving the study of a process
CLO3	Analyse and prepare flow sheet involving PFD & PID
CLO4	Prepare heat and mass balance and detailed design of some plant items
CLO5	Identify and use the application of Economics and Safety consideration

No.	**Course Learning Outcome – CHE 573 – Engineering Management I**
CLO1	Manage people, organisation and environment for achieving competitive advantage
CLO2	Critically analyse, evaluate and manipulate management theories and practices
CLO3	Prepare an organizational plan and execute planning process based on the goals and objectives
CLO4	Design organizational structure and establish the relationship among departments.
CLO5	Demonstrate staffing and related human resource development functions to manage and appraise employees.
CLO6	To understand the practical implications of studying management with regards to the corporate world. Lead employees, subordinates and propose control activities in organizations

No.	**Course Learning Outcome – CHE 574– Engineering Management II**
CLO1	Describe the concept of management laying more emphasis on Engineering aspect/role in management
CLO2	Identify forms of business enterprises and financial management
CLO3	Analyse and use accounting principles, standard and marginal costing, budgeting techniques and budgetary control
CLO4	Demonstrate the application of production management, types of production and factors of production for management
CLO5	Application of linear programming, simplex method for optimal conditions to solve Engineering problems

No.	**Course Learning Outcome – CHE 581 – Petroleum Refining and Processing**
CLO1	Introduction to the history and development of refining,
CLO2	Identify and use the composition of petroleum and testing methods to solve problems involving the study of a refining
CLO3	Introduction to processing refinery and distillation process
CLO4	Identify and use the fractionation equipment, heat exchangers, tube, still and carrying out chemical treatment
CLO5	Demonstrate the application of design of refining equipment, types of refining products, properties and application

No.	**Course Learning Outcome – CHE 582 – Petrochemical Processing and Technology/Petrochemicals**
CLO1	Analyze the sources of petrochemicals, thermal cracking, catalytic cracking and reforming processes
CLO2	Explain the concept behind natural gases, refinery gases and their utilization
CLO3	Analyse the manufacturing processes of methyl alcohol, formaldehyde, hydrocarbons and its use/benefits
CLO4	identify and use chlorination reactions and oxidation processes
CLO5	Describe the process of soap and detergents manufacturing, isopropyl alcohol, and acetylene based synthesis

No.	**Course Learning Outcome – CHE 583 – Coal Utilization and Processing Technology**
CLO1	Introduction to coal formation, physical and chemical properties of coal
CLO2	Classification and characteristics of coal
CLO3	Analyse the rates of coal pyrolysis and gasification reaction
CLO4	Apply coal combustion method to solve Engineering problem
CLO5	Introduction to the sources of world energy, selected topics in energy conversion, relevance of energy conversion technology to Nigerian economy

No.	**Course Learning Outcome – CHE 584 – Energy Conversion Technology**
CLO1	Generally, the concept of energy is brought to light paying more emphasis on various classification and sources of energy
CLO2	Application of thermodynamic consideration to solve Engineering problems
CLO3	Apply Einstein equation in solving problems
CLO4	Study the various types and utilization of energy
CLO5	Application of alternative energy sources to solve Engineering and world problems
CLO6	Explain the concept of energy conversion processes, energy storage and energy politics

No.	**Course Learning Outcome – CHE 597 –Technical Communication (Seminar)**
CLO1	Develop presentation skills and provide transfer of knowledge effectively to an audience
CLO2	Analyze scientific literature for assimilating knowledge
CLO3	Write technical documents and give oral presentations
CLO4	Describe acquired information using a variety of modern presentation tools
CLO5	Identify a current engineering problem of professional interest, analyze it and propose a preliminary work plan to solve it.

No.	**Course Learning Outcome – CHE 585 – Electives**
CLO1	Understand Chemical Engineering concepts in Biomedical systems
CLO2	Metallurgy and corrosion control
CLO3	Chemical Process Synthesis and Simulation
CLO4	Introduction to Nuclear Chemical Engineering
CLO5	Glass and Ceramics Technology
CLO6	Food Processing Engineering
CLO7	Pharmaceutical Technology
CLO8	Reservoir Engineering
CLO9	Petroleum Geology, Petroleum exploration, crude oil production, Pollution control and Natural Gas Production

No.	**Course Learning Outcome – CHE 586 – Biochemical Engineering II**
CLO1	Describe the principles of biotechnology
CLO2	Analyze the methods of genetic modification of prokaryotic and eukaryotic organisms, to optimize biochemical characteristics and to stabilize cellular
CO3	Application of structure transformation transduction, conjugation and protoplasm fusion
CLO4	Understand the advantages and method of induced phage virus bacterial plasmid or vector DNA mapping techniques
CLO5	Application of the present and future prospect of utilization of created gene pools in selected topics of application areas
CLO6	Describe the Microbial enzyme technology, bioreactor design, practice of post-harvest technology and agricultural waste recycling system and process.

No.	**Course Learning Outcome – CHE 588 – Polymer Science and Technology/Engineering**
CLO1	Understand the concept of polymer and their characteristics
CLO2	Study the source of monomers, structure and physical properties of polymers
CLO3	Apply the William Landel Ferry equation in solving complex Engineering problems
CLO4	Introduction to polymerization reactions and manufacturing methods
CLO5	Study the Ziegler Natta Catalysis, processing and technology of polymers

No.	**Course Learning Outcome – CHE 599 – Research Project**
CLO1	Ability to effectively gather and interpret information from literature survey.
CLO2	Ability to use knowledge gathered through literature survey to identify, formulate, analyze and solve complex problems and to evaluate and interpret various solutions
CLO3	Gain the ability to communicate effectively with written, oral, and visual means in a technical setting
CLO4	Ability to use modern techniques of characterization and analysis of materials
CLO5	Students will be able to carry out calculations involved in syntheis, characterisation, and evaluate alternate assumptions, approaches, and procedures. Ability to fabricate system components related to engineering problems giving consideration to environment and society
CLO6	Complete an independent research project, resulting in at least a thesis publication, and research outputs in terms of publications in SCI indexed journals and conference proceedings

Criterion 4- CURRICULUM AND LEARNING PROCESS

COURSE CONTENT SPECIFICATIONS/SYLLABUS

100 LEVEL COURSES

GST 111: Communication in English I (2 Units)

Effective communication and writing in English Language skills, easy writing skills (organization and logical presentation of idea, grammar and style), comprehension, sentence construction, outlines and paragraphs.

GST 121: Use of Library, Study Skills and ICT (2 Units)

Brief history of libraries; library and education, University libraries and other types of libraries, study skills (reference services); Types of Library materials, using library resource including e-learning, e-materials, etc., ; understanding library catalogues (card, OPAC, etc.,) and classification; copyright and its implications; Database resources; Bibliographic citations and referencing. Development of modern ICT; Hardware technology; Software technology; Input devices; storage devices; output devices; communication and internet services; word processing skills (typing etc.)

GST 112: Communication in English II (2 Units)

Logical presentation of papers; phonetics; Instruction on lexis; Art of publics peaking and oral communication; figures of speech; précis; Report writing.

GST 118: Peace and Conflict Resolution (2 Units)

Basic concepts in peace studies and conflict resolution; peace as vehicle of unity and development; conflict issues; Types of conflict, e.g., Ethnic/religious/political/economic conflicts, Root causes of conflict and violence in Africa; Indigene/settler phenomenon; peace-building, management of conflict and security. Elements of peace studies and conflict resolution, developing a culture of peace; peace mediation and peace-keeping; Alternative dispute resolution (ADR). Dialogue/arbitration in conflict resolution; Role of international organizations in conflict resolution e.g., ECOWAS, Africa Union, United Nations, etc.,

MEC 122: Basic Engineering Drawing (2 Units)

Introduction to Engineering Drawing as a means of communication. Drawing paper format. Use of drawing instruments. Types of lines sand their uses in Engineering Drawing. Circles and tangent. Circles to satisfy conditions involving other circles, lines and points. Conic sections, various methods of their construction.

Cycloid, epi and hypocycloids. Involute. Archimedes spiral. Loci: the helix (cylindrical and conical) single and multi-start threads. Coiling of compression and tension springs. Loci-Paths of points on moving link work. The theory of projection. Perspective (briefly), parallel projections (oblique general, cavalier, cabinet). (Orthographic-Multi-view, two views, three views, auxiliary views). (Axonometric-Isometric, diametric, trimetric). Multi view representation. 1st and 3rd angle representations. Isometric drawing. Oblique drawings. Revisions.

ICH 111: General Chemistry I (3 Units)

Atoms, molecules and chemical reactions. Modern electronics theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence forces and structure of solid. Chemical equations and stoichiometry; chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermos chemistry; rates of reaction, equilibrium and thermodynamics. Acids,

bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

ICH 112: General Chemistry II (3 Units)
History survey of the development and importance of Organic chemistry, electronic theory in organic chemistry. Isolation and purification of organic compound. Determination of structures of organic compounds including qualitative and quantitative analysis inorganic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereo chemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkylamines, nitriles, aldehydes, ketones, carboxylic acids and derivative. The chemistry of selected metals and non-metals. Comparative chemistry of groups 1A, IIA and IVA elements. Introduction to transition metal chemistry.

ICH 197: General Practical Chemistry I (1 unit)
Laboratory experiments designed to reflect the topics taught in ICH 112 and ICH 111 such as qualitative and quantitative chemical analysis, acid-base titrations. Gravimetric analysis. Calculation, data analysis and presentation. Functional group analysis.

ICH 198: General Practical Chemistry II (1 Unit)
Continuation of laboratory experiments designed to reflect the topics taught in ICH 111 and IC 112. Some of the experiments will have been carried out in ICH 117.

MAT 111: Elementary Mathematics I (3 Units)
(Algebra and Trigonometry)
Elementary set theory, subsets, union, intersection, complements, Venn diagrams. Real members, 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-Moire's theorem, in throats of unity. Circular measures, trigonometric functions of angles of any magnitude, addition and factor formulae.

MAT 112: Elementary Mathematics II (3 Units)
(Calculus)
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. Trapezoidal and Simpon's rule).

PHY 111: General Physical 1 (3 Units)
(Mechanics, Thermal Physics and Waves)
Space and Time, Units and Dimension, kinematics, fundamental Law of mechanics, statics and dynamics, work and energy, conservation laws. Moments, and energy of rotation; simple harmonic motion, motion of simple system, elasticity; Hooke's law. Young's shear and bulk moduli, Hydrostatics; pressure; buoyance, Archimedes' principles, surface tension; adhesion cohesion, capillarity, drops and bubbles, Temperature, heat, gas, law, laws of thermodynamics; kinetic theory of gases; sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sounding gases, solid and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY 112: General Physics II (3 Units)
(Electricity, Magnetism and Modern Physics)
Electrostatics; conductors and currents; dielectrics, magnetic fields and electro-magnetic induction; Maxwell's equations; electromagnetic oscillations and waves; coulomb's law; methods of charging; ohm's law and analysis of DC circuits; AC voltages applied to inductors, capacitors and resistance. Applications.

PHY 197: General Practical Physics I (1 Unit)
Introductory course emphasizes quantitative measurements, the treatment of measure errors, and graphical analysis. A Variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 111 and PHY 112. However, emphasis should be place on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PHY 198: General Practical Physics II (1 Unit)
This is a continuation of the experiments designed for PHY 111 and PHY 112 some of which have been covered under PHY 197.

CEE 121: Computer Programming (3 Units)
Introduction to computers and computing problems solving on computer algorithms, design using flowchart and pseudo-code. Introduction to high level programming languages. Basic and FORTRAN syntax, flow of control, input/output constructs, data types. Programming in FORTRAN. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

MME 112: Engineering Materials (3 Units)
Introduction to electronics configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationship between structure and properties of metals, alloys, ceramics and plastics. Principles of eh behavior of materials in common environments. Fabrication processes and applications.

200 LEVEL COURSES
ENS 222: Introduction to Entrepreneurship (2 Units)
Introductory entrepreneurial skills. Relevant concepts: Enterprise, entrepreneur, entrepreneurship, Business, Innovation, Creativity, Enterprising and entrepreneurial attitude and behavior. History of entrepreneurship in Nigeria. Rationale for entrepreneurship, creativity and innovation for entrepreneurs. Leadership and entrepreneurial skills for coping with challenge. Unit operations and time management. Creativity and innovation for self-employment in Nigeria. Overcoming job creation.
Challenges. Opportunities for entrepreneurship, forms of businesses, staffing, marketing and the new enterprise. Feasibility studies and starting a new business. Determining capital requirement and raising capital. Financial planning and management. Legal issue, insurance and environmental consideration. Also, to be incorporated, on the other side of the spectrum, are employability, skills-interview techniques, oral presentation skills, etc.,

EEE 221: Applied Electricity I (3 Units)
Fundamental concepts-electric field, charges, magnetic fields. Current B-H curves Kirchhoff's laws, superposition. The venin, Norton theorems, Reciprocity, RL, RC RLC

circuit. DC, AC bridges, Resistance, capacitance, inductance measurement, transducers, single phase circuits, complex J-notion, AC circuits, impedance, admittance, subscription.

EEE 222: Applied Electricity II (3 Units)

Basic machine – DC, synchronous alternators, transformers, equivalent circuits. Three phase balanced circuits, PN junction Diode, transistors, thyristors FRTs, Zener, Rectifiers. Basic control systems, open/close loop systems. Communications fundamentals, introduction of TV, Radio Telephone systems.

MEC 223: Engineering Drawing I (2 Units)

Revision of multi-view representation. Harder examples on two and three view representation ($1^{st}$and 3^{rd} Angles). Harder examples on isometric drawing to include simple pictorial assembly drawing in isometric. Harder examples on oblique drawing (Cavalier, Cabinet and Angles other than 45 degrees). Dimensioning. Sections and conventions. Auxiliary views. Representation and specification of threads. Bolted joints. Keys and cottered joints. Conventional representations (see BS 308).

MEC 224: Engineering Drawing II (2 Units)

Further works on projections; projection of points, lines, planes and solids. Intersections of solids. Cams. Interpretation of solids. Development of surfaces. Detail drawing belts, chains, gears, bearing and lubrication arrangements. Couplings brake, flexible shafts, universal joints, etc. assembly drawings. Revisions

FEG 294: Student Workshop Experience (1 Unit)

Introduction to practical and skills in general engineering through instruction in operation of hand and powered tools wood and metal cutting and fabrication. Supervised on experience in safe usage of tools and machines for selected tasks.

CHE 225: Fundamental of Fluid Mechanics (2 Units)

Properties of fluids, fluids statics conservation laws, friction effects and losses in laminar and turbulent flows ducts and pipes. Dimensional analysis and dynamic similitude, principles of construction and operation of selected hydraulic machinery. Hydro power systems.

CEE 221: Introduction to Modeling and Simulation (2 Units)

Introduction to computers and computing problems solving on computer algorithms, design using flowchart and pseudo-code. Introduction to high level programming languages. Basic and FORTRAN syntax, flow of control, input/output constructs, data types. Programming in FORTRAN. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

CHE 226: Fundamental of Thermodynamics (2 Units)

Basic concepts, quantitative relations of Zeroth, first, second and third laws of thermodynamics. Behavior of pure substances and perfect gases. Ideal gas cycles.

CVE 227: Applied Mechanics (2 Units)

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

CVE 228: Strength of Materials (2 Units)

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.

FEG 221: Engineering in Society (2 Units)

Philosophy of science and engineering. History of engineering and technology. The engineering profession-engineering-engineering literacy professional bodies and engineering

societies. Engineer's code of conduct and ethics. Engineers and nation building economy, politics, business, safety in Engineering and introduction in Risk analysis, invited lecturers from professionals.

FEG 227: Engineering Mathematics I (3 Units)

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.

FEG 228: Engineering Mathematics II (3 Units)

Second order differential equations, line integral multiple integral and their applications, differentiation of integral. Analytical functions of complex variables. Transformation and mapping. Special functions.

FEG 293: General Engineering Laboratory Course (1 Unit)

Laboratory investigation and report submission for selected experiments and projects in Thermodynamics, Applied Mechanics and Applied Electricity and Fundamental of fluid mechanics.

FEG 290: Students Industrial Work Experience (SIWES I) (2 Units)

On the job experience in industrial chosen of practical working experience but not necessarily limited to the student's major (8 weeks during the long vacation following 200 Level).

300 LEVEL COURSES

ENS 311: Entrepreneurship Practicum (2 Units)

Profiles of business ventures in the various business sectors such as: Soap/Detergent, Toothbrush and Toothpaste making; photography; Brick making; Rope making, Brewing; Glassware production/ceramic production, paper production; water treatment/ conditioning/ packaging; food processing/ preservation/packaging, metal fabrication, training industry; vegetable oil extraction; farming; fisheries/aquaculture; plastic making; refrigeration/Air-conditioning; carving, weaving, bakery; tailoring, printing, carpentry, interior decoration, animal husbandry etc. case study methodology applied to the development and administration of cases that bring out key issues of business environment, start up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during case presentations.

FEG 321: Engineering Mathematics III (3 Units)

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 vectors, field, Gauss, Greens and Stroke's theorems and applications. Singular values functions. Multi valued functions, analytical functions, Cauchy Riemann's singularities and Zeroes, Contour Integration including the use of Cauchy's integral theorems, Bilinear Transformation.

CHE 301: Process Instrumentation (2 Units)

Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems.

CHE 331: Transport Phenomena I (Heat Transfer) (2 Units)

Compressible flow: Normal shockwaves. Non-Newtonian fluids. Radiation: Mechanism of radiative heat transfer. Heat exchange between radiating surfaces. Unsteady state conduction. Free and forced convective heat transfer. Determination of heat transfer coefficients.

Application to design of heat exchanges. Diffusion of vapours. Diffusion in liquids and solids.

CHE 333: Transport Phenomena II (Mass Transfer) (2 Units)
Boundary layer theory and turbulence. Navier-Stokes equations. Universal Velocity profile. Condensation and boiling. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Inter-phase mass transfer.

CHE 335: Particle Technology (2 Units)
Properties of particles. Motion of particles in a fluid, Stroke's and Newton's Laws. Flow through packed beds. Fluidization. Sedimentation and flocculation. Filtration. Screening, Classification and grinding.

CHE 341: Chemical Engineering Thermodynamics I (2 Units)
Cycles, Carnot; thermodynamic Turbines Seamand Gas, Refrigeration; General P-V-T Relations. The P-V-T behaviour of pure substances; Equation of state for gasses; the principle of corresponding state; Compressibility relations; reduced pressure; reduce volume; temperature; pseudo critical constants. P-V-T approximations for gaseous mixture ideal gas mixtures. Dalton's law of additive pressure; Amagat's law of additive volumes; Pseudo critical point method; Kay's rule, Gilliland's method; Behaviour of liquids. Heat Effects. Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clausius-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_20, etc., partial enthalpies, single and multiple effect evaporators with regards to heat effects. Thermodynamics of Flow Processes. Fundamental equations, continuity equation; equation of motion; energy equation; Bernoulli's equation; Flow in pipes, laminar and turbulent flows; Reynolds number, friction factor. Fanning equation; Flow meter, Nozzles; Compressors single stage and multistage, effect of Clearance.

CHE 351: Chemical Reaction Engineering I (2 Units)
Measurement and analysis of wreathing reaction. Homogeneous reactions. Catalysis. Chain reactions. Kinetics of heterogeneous and catalytic reactions. Photochemistry. Absorption of gases on solids. Application to gas chromatography.

CHE 361: Introduction to Material & Energy Balances/ Chemical Process Principles (2 Units)
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. Program of analysis of material balances. Program of analysis of material balances problem, problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving components (elements). Recycle, Bypass, Purge; Effect of recycle and purge on mass and energy balances. Gases, vapours, liquid and solids. Ideal gas law, Real gas relationships. Vapour pressure. Saturation. Partial saturation and humidity. Material balanced involving condensation and vaporization phase phenomena. Energy balances. Concepts and Units. Heat capacity. Calculation of enthalpy changes without change phase. Enthalpy for phase transition. General Energy balance. Reversible process the mechanical energy balance. Heat of reaction. Heat of solution and mixing combine material and energy balances; Application fundamental concept of mass and energy balances and mass transfer to unit operation in distillation. Simultaneous use of material and energy balances for the steady state. Enthalpy concentration chart. Humidity chart and their use. Complex problems; Lever rule Geometrical construction for mass. Energy

balances for adiabatic and non-adiabatic process. Unsteady state material and energy balances.

CHE 391: Chemical Engineering Laboratory I (2 Units)

Laboratory experiments in transport phenomena. Kinetics and separation process.

FEG 322: Engineering Mathematics IV (3 Units)

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

FEG 390: Students Industrial Work Experience II (SIWES II) (3 Units)

On the job experience in industrial chosen for practical working experience but not necessarily limited to the student's major (12 weeks during the long vacation following 300 level).

CHE 332: Separation Process I (2 Units)

Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation. Leading. Hydrodynamics of packed and plate columns.

CHE 352: Chemical Reaction Engineering II (2 Units)

Types of reactions, Reaction rate, variables determining reaction rate; Arrhenius rate expressions from postulated mechanisms; interpretation of batch reaction data. Integral and differential methods of analysis, Reversible, parallel, series, autocatalytic reactions, Optimization of output and yield from reactor, Comparison of various performances (PRR, CSIR, BR), Photochemistry.

CHE 362: Process Simulation and Statistics for Physical Science & Engineering (2 Units)

Introduction to process simulation using the HYSYS software or any other process simulation software. 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, tests hypothesis and significance. Regression and correlation.

CHE 364: Chemical Process Design and Evaluation I (2 Units)

General design considerations, Sources of design information: Equipment and flow-sheet symbols, Process design and development. Establishment of workable manufacturing processes, process conditions and facilities, Optimum design considerations. Process design of mass transfer equipment. Evaluation techniques, Development and presentation of design report.

CHE 380: Polymer Process Engineering (2 Units)

Introduction to the manufacture, processing, and applications of organic polymeric materials. The chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers are covered.

CHE 382: Biochemical Engineering I (2 Units)

Introduction to microbiology and biochemistry. Classification and growth characteristics of micro-organisms. Enzymes in engineering. Microbiolculture processes in manufacturing industries.

CHE 392: Chemical Engineering Lab. II (2 Units)

Laboratory experiments in transport phenomena. Separation processes and thermodynamics.

400 LEVEL

CHE 435: Separation Processes II (2 Credits)

Stage-wise and continuous contactors; Binary distillation; Leaching; Backed and plate columns; Drying of solids Multiple effects evaporators; Crystallization; Reverse Osmosis; Humidification, water cooling tower, solvent extraction, gas absorption; Ion-exchange operations; Condensation and boiling.

CHE 437: Transport Phenomena III (2 Credits)

Boundary layer theory; Navier strokes equation, universal velocity profile. Fick Law Gas diffusion; Maxwells diffusion law. Winkelman's two film theory; Highie's penetration theory; Dankert's random surface renewal; Mass transfer coefficients.

CHE 443: Chemical Engineering Thermodynamics III (2 Credits)

Carnot cycle; Thermodynamic cycle; The steam power plant, refrigeration and air conditioning cycles, liquefaction processes; Thermodynamic approach to fluid mechanics, thermodynamic of flow processes, conservation of mass and energy, the sonic velocity, metering and throttling processes, nozzles, compressors, ejectors.

CHE 405: Chemical Process Dynamics and Control (2 Credits)

Process dynamics, optimization, control, automation, dynamic analysis, models - mass-spring system, electrical R-C circuits, analogue computers; Response of first order systems, Laplace transformation, stability consideration, process control; Introduction to multi-variable control, the control valve.

CHE 465: Chemical Process Design and Evaluation 1I (2 Credits)

Sources of design data; Process charts and flow sheets, design selection, specification and design of heat transfer equipment; Mechanical design of process vessels and piping; Environmental consideration; Introduction to computer aided design and simulation. Case studies/mini projects.

CHE 471: Chemical Process Economics (2 Credits)

Types of investments, rate of return and other investment return techniques; Cash flow analysis, present worth methods, in choosing alternative investments; Discount cash flow analysis; Production cost; Breakeven analysis; Replacement problems - buy and hire considerations; Economic of scale, risks and uncertainty on investments including sensitivity analysis.

CHE 485: Chemical Technology (2 Credits)

The Nigerian Chemical Industry, utilization of raw materials, coal, petroleum, natural gas, air, water, agricultural products, wastes, manufacture of hydrogen and synthesis, gas, catalytic reforming of hydrocarbons with stream, ammonia, synthesis, nitrogenous fertilizers, ethylene.

CHE 483: Environmental Pollution and Control (2 Credits)

Principal pollutants and their sources; Municipal, industrial; Air pollution, technological sources of air pollution, principal pollutant emitted from combustion chambers; particulate, non-combustibles, unburnt particles, particles formed during combustion gasses, organic pollution. Combustion, noise, and dust.

CHE 493: Chemical Engineering Laboratory III (2 Credits)
Further laboratory experiments in transport phenomena, kinetics and separation processes.

CHE 496: Technical Writing (1 Credit)

CHE 490: Students Industrial Work Experience III (SIWES III) (2 Credits)
On the job experience in industrial choice of 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 sessions. Thus, the second semesters at 400 Level are spent in industry).

500 LEVEL COURSES

CHE 501: Loss Prevention in Process Industries (2Credits)
Hazards in chemical process industries. Safety in plants. Causes of accidents in process plant. Prevention of accidents. Hazop technique. Maintenance of plant to minimize losses. Waste disposal and efficient treatment. Pollution control. Legal implications of various losses.

CHE 539: Separation Processes III (2 Credits)
Humidification and water-cooling; Solvent extraction; Extractive and azeotopic distillation; multi-component gas absorption; Distillation of multi-component mixtures; Novel distillation processes; Chromatography.

CHE 554: Chemical Reaction Engineering III (2 Credits)
Introduction to applied catalysis; Physical adsorption, chemisorption, adsorption isotherms, heat of adsorption selectivity, catalyst preparation, criteria and test of catalyst performance, characterization of the physiochemical properties of catalysts, texture and acidity of solid catalyst, deactivation of catalysts, kinetics and mechanisms of some industrial catalytic processes.

CHE 502: Chemical Process Optimization (2 Credits)
Theory of maxima and minima; Optimum searching techniques; analytical optimization procedures; Constrained and unconstrained problems; Theory of linear programming and its industrial application; unconstrained peak. seeking methods; Single and multi-variable search techniques; Constrained optimization techniques. Dynamic programming; Numerical optimization techniques; Discrete events.

CHE 567: Chemical plant Design (2Credits)
A design problem involving the study of a process; Preparation of a flowsheet, preparation of heat and mass balance and detailed design of some plant items; Economics and safety considerations must be stressed.

CHE 573: Engineering Management I (2 Credits)

Critical study of the financial and Allied companies, Decree of 1990; Company law. Management and Finance, Memorandum and Articles of Association.

CHE 574: Engineering Management II (2 Credits)
Types and functions of management; Forms of business enterprises; Financial Management.

Accounting principles, standard and marginal costing, budgeting techniques and budgetary control. Production management: types of production and factors of production for management; Production management techniques, inventory or stock control, network analysis, critical path, application of 'linear programming, simplex method for optimal conditions.

CHE 581: Petroleum Refining and Processing (2Credits)
History and development of refining, -composition of petroleum and testing methods; Introduction to processing refinery and distillation process; Fractionation equipment, chemical treatment, heat exchangers, tube, still etc. Design of refining equipment; Types of refinery products, properties and application.

CHE 582: Petrochemical Processing and Technology (2 Credits)
Sources of petrochemicals, thermal cracking, catalytic cracking Reforming, natural gas and its utilization, refinery gases and their utilization. Carbon monoxide-based synthesis: manufacture of methyl alcohol, formaldehyde, hydrocarbons; Chlorination reactions and oxidation: Dichloroethane and isopropyl alcohol. Acetylene based synthesis; Manufacture of soap and detergents.

CHE 583: Coal utilization and Processing Technology (2 Credits)
Introduction to coal formation, physical and chemical properties of coal. Coal classification and characteristics; Rates of coal pyrolysis and gasification reaction, coal combustion. Sources of world energy; Selected topics in energy conversion; Relevance of energy conversion technology to Nigerian economy.

CHE 584: Energy Conversion Technology (2 Credits)
Energy classification and sources: Thermodynamic consideration; Mass-Energy dependence; Einstein equation, energy types and utilization; Alternative Energy sources; Energy conversion processes; Energy storage; Energy politics.

CHE 597: Technical Communication (Seminar) (2 Credits)
Oral communication: speaking skills with effective use of statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Written communication: principle of technical communication – in particular use in design and research reports.

CHE 585: ELECTIVES (2 Credits)

- Chemical Engineering in Biomedical systems
- Metallurgy and corrosion control.
- Chemical Process Synthesis and Simulation.
- Introduction to Nuclear Chemical Engineering.
- Glass and Ceramics Technology.
- Food Processing Engineering.
- Pharmaceutical Technology.
- Reservoir Engineering.
- Petroleum geology. Petroleum exploration. Crude oil production. Pollution control. Natural gas production.

CHE 586: Biochemical Engineering II (2 Credits)
Introductory Biotechnology. Definition and principles of biotechnology; areas of application in biotechnology. Methods of genetic modification of prokaryotic and eukaryotic organisms; to optimize biochemical characteristics and to stabilize cellular. Structure transformation transduction; conjugation and protoplasm fusion. Natural DNA recombination; advantages and method of induced phage virus bacterial plasmid or vector DNA mapping techniques; present and future prospect of utilization of created gene pools is selected topics of application areas e.g., Microbial enzyme technology, bioreactor design; practice of postharvest technology and agricultural waste recycling.

CHE 588: Polymer Science and Technology/Engineering (2 Credits)
Introduction to polymer and their characteristics. Source of monomers. Structure and physical properties of polymers: rheology, solubility and molecular weights. Plasticity and elasticity. The William Landel Ferry Equation, Polymerization reactions and manufacturing methods; Ziegler Natta catalysis. Processing and Technology of Polymers.

CHE 599: Research Project (6 Credits)
Individual research projects under the supervision of an academic staff. Projects should focus on National, State and Industrial needs and problems.