UNIVERSITY COURSES

Chemical Engineering Department

MTH 101 ELEMENTARY MATHEMATICS 1 (3,1,0)

Number systems. Indices, Surds and Logarithms. Polynomials. Remainder and factor theorems. Polynomial equations. Rational function. Partial fractions. Fields. Ordered fields. Inequalities, Mathematical induction. Permutations and combinations. Binomial theorem. Sequences and series. The quadratic equation and function. Relation between the roots and the coefficients. Complex numbers. Addition, Subtraction, Multiplication and Division. Argand diagram, De-Moivre's theorem N-th roots of complex numbers.

Elementary set theory. Venn diagrams and applications. De-Morgan's laws. Trigonometry. Elementary properties of basic trigonometric functions. Addition formulae and basic identities. Sine and Cosine formulae. Half angle formulae. Area of triangle. Solution of trigonometric equations. Inverse trigonometric functions, functions, concepts and notation. Example. Composition. Exponential and logarithmic functions. Graphs and properties. Limits and continuity. Techniques for finding limits. The derivative. Calculation from first principles. Techniques of differentiation. Chain rule. Higher order derivative. Extremun problems. Mean-value theorem. Applications. Indeterminate forms and L'Hospital rule. Taylor's and Maclaurin's series. Curve sketching. Integration as the reverse of differentiation, as area, as limit of finite sums. Definite integrals. (pre-requisite: Credit- O'level Mathematics)

MTH 102 ELEMENTARY MATHEMATICS II (3, 1, 0)

Transcendental functions. Hyperbolic functions. Inverse functions. Logarithmic differentiation. Methods of integration, integration of rational functions. Integration by substitution, integration by parts. Improper integrals. Applications. Areas and volumes. Centre of mass. Ordinary differential equations. First order equation, second order homogenous equations with constant coefficients. Applications. Plane analytic geometry. Rectangular Cartesian coordinates. Distance between two points. The straight line. Loci. The circle, parabola. Ellipse and hyperbola. Second degree curves. Plane polar coordinate system. Graphs of plane equations. Plane areas in polar coordinates. Vectors. Vector addition and implications. Products of three or more vectors. Vector functions and their derivatives. Velocity and acceleration. Matrix algebra. Addition and multiplications, transpose. Determinants. Inverse of non-singular matrices, Cramer's rule and application to the solution of linear equations. (Examples should be limited to non matrices where m3, n3) transformations of the plane. Translation, reflection, rotation, enlargement, shear. Composition of transformations. Invariants, points and lines.

(Pre-requisite. Credit O.L. Math).

CHM 101 GENERAL CHEMISTRY I (2,1,1)

Atomic structure and the periodic classification of the elements, ionic and covalent bonding including the effect of dipole-dipole interaction of Physical properties. Redox reactions and the concepts of oxidations numbers; introduction to nuclear chemistry. Solids and lattice structure; acid-base reactions; general principles of extraction of metals.

CHM 102 GENERAL CHEMISTRY II (2,1,1)

Physical and chemical equilibrium, elementary electrochemistry and chemical kinetics. Survey of reactions of function groups in aliphatic and aromatic compounds concept of hybrid bonds, Alkanes, alkenes, alkynes, reactions of carbon-carbon multiple bonds; elimination and substitution reactions of alcohols and alkyl halides; addition and elimination reactions in benzene; hydroxyl groups and carbonyl compounds, organic acids, bases and derivatives.

PHY 101 GENERAL PHYSICS I (2,1,1)

Two 1-hour lectures, one hour tutorial and three hours laboratory per week.

Mechanics. Space and time, units and dimensions; Vectors; Kinetics, Newton's Laws; Galilean invariance, statics and dynamics of particles; universal gravitation; work and potential energy; conservation of energy and momentum; right bodies; fluid mechanics. Thermal physics; thermal properties, including elementary thermodynamics and kinetic theory.

(Pre-requisite: credit in O.L. Physics and Mathematics and concurrent registration in MTH 101).

PHY 102 GENERAL PHYSICS II (2,1,1)

Two 1-hour lectures, one hour tutorial and three hours laboratory per week.

Electricity and Magnetism: Electrostatics: conductors and current; dielectrics; magnetic field and induction: Maxwell's equation; electromagnetic oscillations and waves. Geometrical Optics: Geometrical methods applied to the optics of mirrors, lenses and prisms.

(Pre-requisites: Previous registration PHY 101 and MTH 101).

BIO 101 BIOLOGY FOR PHYSICAL SCIENCE (2,0,1)

The biological world and its evolution: call structure and function, reproduction, genetics, evolution and evolution and ecology. Human physiology: the heart, eye, ear, lung and

kidney, the respiratory system, temperature regulation, pulmonary circulation, the nervous system, electrical activity of the brain, living cells, hormones and genes.

GST 101 USE OF ENGLISH I (1,1,0)

Use of library. Use of words and sentence construction. Functions of sentences-purpose structure, correct use of verbs (action words), word order and punctuation, Essay/Composition writing. Paragraphs-structure, function, links and style. Exposition-description and explanation. Special types of exposition e.g letter writing, layout of a business letter, technical reports-including terms of reference, drafting and editing of reports.

GST 102 USE OF ENGLISH II (1,1,0)

Comprehensive and interpretation-reading efficiency of technical and non-technical material. Note taking; techniques of note taking from reading and from lectures, précis-writing or summarizing methods, technical vocabulary, work formation, use of classical and official terms, special terms, acronyms, new words, choice of correct words, definitions by example, synonym or antonym, analytic or operational definitions; basic-words in fields of specialization, e.g. mechanical, electrical, civil, aeronautical, agricultural, automobile engineering, metallurgy, mathematics.

GST103 HUMANITIES (1,0,0)

The nature and scope of economics. The Nigerian Political system: policy and means of production in Nigeria. The structure of the Nigeria economy; aspects of economic and technological dualism; internal migration-rural to urban migration and the informal sector. The role of capital growth and development; public investment Criteria; choice of “Appropriate” or relevant” technology. Human resources development in Nigeria rural utilization, education and manpower development and planning.

Agriculture in the development process; land tenure and reform, agricultural technology and the green revolution and integrated rural development. Industrialization; role and type of industry, choice of techniques, impact substitution, and export expansion.

The economic role of the government expenditure and taxation; the federal structure, fiscal federalism and revenue allocation; the financial system. Problems of development planning and plan implementation in the Nigeria Federal System of Government. Prospects of the Nigeria economy.

GST 108 SOCIAL SCIENCE I (1,1,0)

A global perspective of economics, institution and developments. The law of scarcity and the technological choices open to any society. Trade development with special reference to trade in primary products, imports substitution and export possibilities in Nigeria's balance of payments and commercial policies.

Economics integration or unions. State and structure of economics of ECOWAS countries. Nigeria and ECOWAS: prospects for industrialization, trade; fiscal and monetary policies for accelerated industrialization. Nigeria, the ECA and Economics Co-operation in Africa.

GST 110 SCIENCE, ENGINEERING AND TECHNOLOGY IN SOCIETY (1,1,0)

Science in society: History and nature of science. Methods and tools of science: research and inventions, units and dimensions. Science and culture. Frontiers of science; food material, energy, population control, environmental pollution. Careers in science and Agriculture.

Introduction to Engineering: What Engineers do and how it is done. Tools of engineering, units and dimensions. Social, political and economical consequences of engineering projects. Professional ethnics and conduct. Careers in Engineering.

History and impact of Technology on society: Role of scientists and engineers in government decision making. Case studies of contemporary problems; agriculture, rural development, industrialization, import/export, the economy. Technology and culture; past and president attitudes and concerns of society.

GST 201 NIGERIA AND AFRICAN CULTURAL DEVELOPMENT. SOCIAL SCIENCE II (1,0,0)

Concepts and meaning of development tradition. African its geographical and ethnographical review, its family structure kinship system etc., socio-economic preoccupations, political system, art and music, model of communication; African and processes of modernization-education, writing and the cultural revival, mass media and national development.

CSC 201 COMPUTERS AND APPLICATIONS I (2,1,1)

Pre-requisites: MTH 101 & MTH 102

Introduction to digital computer, their use and modern programming techniques: brief history of computers, generation of computers, structure of a general purpose computer. General problem solving, systematic development of algorithms, flow diagrams, meaning of logical processes, analysis of computational problems, coding of programs, verification and validation of programs. Practical experience: Operating computers and peripheral equipment. Extensive practice with one or more higher-level languages. Emphasis on technical application. Elementary numerical algorithms.

MTH 202 MATHEMATICAL METHODS II (2,1,0)

Prerequisites: MTH 101 & 102

Vectors. Products of vectors. Equations and planes. Vector spaces. Linear dependence and independence. Basis and dimension. Linear transformation, matrices. Operations on matrices. Rank of a matrix. Determinants. Inverse of a matrix. Solutions of systems of linear equations. Cramer's rule. Eigen values and eigenvectors. Similarity to diagonal matrices. Bilinear and quadratic forms. Applications.

MTH 203 ELEMENTARY DIFFERENTIAL EQUATIONS (2,1,0)

Prerequisites: MTH 101 &102

Derivation of equations from physics, chemistry biology, geometry, etc., First order equations. Application or first order equations. Second-order linear equations. Fundamental solutions. Linear equations. Methods of dependence and dependence. Wronskian. Properties of solution of linear equations. Methods of Undetermined coefficients and variation of parameters. Applications of second-order linear equations. General theory of fn-th order linear equations. Laplace transform. Convolution. Solution of initial-value problems by Laplace transform method. Difference equations.

STA 211 INTRODUCTION TO STATISTICS AND PROBABILITY (2,1,0)

Frequency distribution, measures of location and dispersion in simple and grouped data. Laws of probability. The binomial, poison and normal distributions. Estimation and tests of hypothesis. Analysis of variance and covariance, simple regression and correlation, contingency table and X2 applications.

Pre-requisites: MTH 101 & 102.

SCHOOL COURSES

ENG 101 WORKSOP PRACTICE I (0,0,1)

General use of Engineering measuring instruments, e.g. calipers, etc. Introduction to hand tools, e.g. practice in wood planers, saws: sander stand pattern making; sampling and sizing techniques of raw materials.

Sheet-Metal Work: production of sheet metal product-layout cutting and shaping, gas welding, soldering, brazing, fastening, assembly.

ENG 102 WORKSHOP PRACTICE II (0,0,1)

Industrial safely: Behavior analysis, safely consciousness. Survey of sources of common accidents. Accident prevention and control.

Machine-shop Works: Lathe-work, instruction on metal working process, shaping, milling, grinding, drilling and metal spinning, etc. Design of simple jigs and fixtures.

Automobile Work: Simple automobile diagnosis and repairs. Electrical workshop practice: convention and application of colour codes and signs, etc. use of the electrical tools. Machines, cables and conductors.

ENG 103 ENGINEERING DRAWING I (0,0,1)

Graphic tools. Introduction to drawing, measuring, lettering and dimensioning of objects in various positions, sketching. Engineering geometry. Fundamentals of orthographic projection, graphs, charts and presentation of data and results.

ENG 104 ENGINEERING DRAWING II (0,0,1)

Guided sketching, freehand drawing, creative thinking and multiview representation. Revolution and conventional practice. Sectional and auxiliary views. Spatial relationships; basic descriptive geometry, vector geometry, developments and inter-sections, pictorial presentation.

ENG 201 ENGINEERING WORKSHOP PRACTICE II (0,0,1)

Pre-requisites: ENG 101, ENG 102

Foundry: sand testing, mixing o sands, preparation of moulds Pattern Making - solid, sweep pattern: hoisting gates and risers. Melting and pouring of metals. Detection of defects. Welding: manual arc welding butt, T-joints, edge preparation, surface cladding, argon arc welding, CO, MIG welding, S.A.

ENG 206 ENGINEERING WORKSHOP PRACTICE IV (0,0,1)

Manufacture of simple engineering/technology products to specifications using machining, foundry, welding and woodworking technologies. Inspection and testing of the manufactured products for accuracy using appropriate equipment and methods.

ENG 209 ENGINEERING THERMODYNAMICS (2,1,0)

Fundamental concepts:

1. History of thermodynamics, dimensions, units, system, state, property, process, heat, work, pressure, temperature, zeroth law.
2. First law of themodynamics: conservation of energy (Joule's experiment), first law, internal energy. Non flow process, enthalpy, steady flow processes.
3. Properties of pure substances P.V.T relations and diagrams Cp, Cv, ideal gas, Thermodynamic Charts and tables.
4. Second law of thermodynamics and heat engine cycles, cannot heat engine and cycle. The second law and its corollaries.
5. Entropy: reversible and irreversible processes. Clausius inequality, entropy, entropy and irreversibility. Heat engine and pump calculations.

Applications of 2nd law to non-flow steady flow, processes. Available and unavailable energy, availability. Gibbs equations.

ENG 212 ENGINEERING ECONOMY (1,1,0)

Introduction of Engineering Economy

Engineering economy and the Engineering Process

Some fundamental Economic concepts

Elementary Selections in economic analysis

Interest and interest formulas

Calculations of equivalence involving interest.

Economic analysis of alternatives

Bases for comparison. Decision making among alternatives. Evaluation replacement alternatives. Breakeven and minimum analysis. The evaluation of public activities. Accounting, Depreciation and income taxes. Accounting and Cost Accounting, Depreciation and depreciation accounting. Income taxes in economy studies.

ENG 203 ENGINEERING DRAWING III (0,0,1)

Design and communication drawings: Tolerance and fits, detail drawings, specification of threads, fasteners, springs, size description, machining and welding symbols, dimensions and specifications. Mechanical, chemical, electrical and civil engineering drawings; machine and assembly drawings, piping drawings and process models, welding drawings, electronics drawings.

ENG 207 INTRODUCTION TO ENGINEERING MATERIALS I (2,0,0)

Pre-requisites: CHM 102, PHY 102

Review of atomic bonding, classification of engineering materials (metals, ceramics, polymers, composites, semiconductors). Introduction to extractive metallurgy.

Elements of crystallography- crystal structures: lattice unit cells, planes and directions, miller indices, inter planar spacing. Packing of shepherds simple cubic, body-centered cubic, face centered cubic, hexagonal close packed structures, atomic packing densities, interstitial sites, sizes and their distribution, imperfections valences and other point defects, line and surface defects. Phase equilibrium and alloy theory, solid solution. Introductory heat-treatment of steels.

ENG 208 INTRODUCTION TO ENGINEERING MATERIALS II (1,0,1)

Non-ferrous engineering alloys and their properties. Mechanical properties engineering materials: plastic deformation of a single crystal, stress and strain curves, strain hardening; creep, toughness and fatigue hardness. Principles of mechanical testing mechanism of ductile brittle. Transition in fracture and ITT curves. Physical properties of materials electrical, optical and magnetic properties of materials: Electronic structure and properties.

Non-metallic materials: ceramics, structures, properties processing methods and applications. Plastic types, structures, processing and application. Composite - types and properties. Wood as an engineering materials. Softwood, hardwood, structures; Nigerian timbers: strength, properties and tests. Environmental stability of materials: corrosion and corrosion control.

ENG 217 ENGINEER IN SOCIETY (1,0,0)

Science, Technology and Engineering -Definition and Historical Development of Engineering, science and Technology.

Role of the Engineer in the Society - in space mission travel, in oil and gas, politics, law, medicine, education, administration, management, utilities, military service, etc.

Professional Qualifications - Engineering education qualification registrable as a Professional Engineer with NSE, COREN, Africa Institute of Science and technology (AIST), etc.

Professional Practice - professional ethics and conducts, professional registration procedures and engineering professional responsibility, management skills, project management, developing new technologies, tools, machines, computers and systems protecting intellectual property rights and business legal rights, handling and energy resources, fossil, geothermal, nuclear, wind and solar.

Safety in Engineering Practice-Control of occurrences of accidents in production industry. Rules and regulations guiding pollution of the environment. Information and Communication Technology (ICT) systems in engineering practice. Financial management knowledge, human relations management essential in developing the Engineer to promote productivity in any enterprise.

ENG 226 INTRODUCTION TO ELECTRICAL AND ELECTRONIC ENGINEERING (1,1,1)

Pre-requisites: MTH 102, PHY 102

Review of electrostatics and electromagnetism. Transient and steady-state analysis of circuits: network theorems and techniques, passive and active circuits and building blocks, sinusoidal analysis and phases. Transformers; principles and operation of electrical machines, motors, generators, single and poly-phase systems.

Introduction to electronic circuits and models: conduction mechanism and junction operation. Device characteristics: properties and applications of diodes, junction transistors and amplifiers. Introduction to integrated circuit technology and digital circuits.

Laboratory:

Analog and digital instrumentation and systems, applications of operational amplifiers, associated laboratory experiments.

ENG 213 ENGINEERING MECHANICS 1 (1,1,0)

Pre-requisites: MTH 101, MTH 102, PHY 101

Basic concepts in static. Static's of particles and rigid bodies in a plane: analysis of forces: distributed forces, flexible cable, friction static and dynamic. Areas, centroids, masses, centres of gravity, analysis of structures: internal forces, Newton's third law, shearing forces, moments, trusses and frames. The basic free body diagrams. General mathematical principles. Moments of inertia of an area Computer application and simulation in statics.

ENG 214 COMPUTER PROGRAMMING FOR ENGINEERING APPLICATIONS (1,0,1)

Introduction to C/C++ programming language. The MAIN ( ) function, comment line, types of conversion, constants, expressions. The print function. The Scan function. The assignment statement, formatted input and output statement, arithmetic operators. The IF statement. Comparison operators, logical operators. Nested IF ELSE Statements UNARY operators

TERNARY operators. Bitwise operators. Combined operators. Table of priority of C/C++ operators. The WHILE top, the DO WHILE loop, the FOR Loop Statement, NESTED Loops, unconditional program branching. The GO TO Statement, the CONTINUE statement, the BREAK and SWITCH statement. Application of C/C++ programming language to solving engineering problems.

ENG 224 ENGINEERING MECHANICS II (1,1,0)

Newtonian principles of dynamics of particles and rigid bodies applied to one-dimensional and two-dimensional motions: Force system resultants, structure analysis, kinematics and kinetics of particles and rigid body motions: methods of impulse and momentum, linear and angular momentum, work and energy, absolute and relative motion concepts. Computer applications and simulation of engineering mechanics and dynamics.

Laboratory:

Experiments illustrating dynamics of particles and rigid bodies, material elasticity, friction and machines.

ENS 301 ENTREPRENEURIAL STUDIES I (1,0,1)

Development Entrepreneurship/Intrapreneurship, the Nigerian, creativity and Intellectual rights, technological Entrepreneurship, innovation: Theories and Management, Family business and succession planning, women Entrepreneurship, social Entrepreneurship, business opportunity set and evaluation, introduction to business strategy, introduction to business ethics and corporate governance, relationship between scientific research innovation and products, product invention, timeliness and processes.

Practice: Group/individual implementation/manufacture/assembly of selected technological products in simulated production environments, construction of physical models of relevant concepts.

ENG 305 STRENGTH OF MATERIALS I (1,1,1)

Pre-requisite: ENG 226

Elementary concepts in two-dimensional theory of elasticity-generalized Hooke's law, equations of equilibrium, strain-displacement and stress-strain relations. Axial force, shear force and bending moments; simple bending theory, shear and moments diagrams. Torsion; combined torsion and bending. Stresses, transformation of stresses, Mohr's circle. Deflection of beams, elementary buckling of columns.

Laboratory:

Mechanical testing of members under axial, bending and torsional loads. Deformation and characteristics stress-strain curves; strength, ductility, brittleness, loading and unloading.

ENG 307 ENGINEERING MATHEMATICS I (2,1,0)

Pre-requisites: MTH 203, ENG 226

Review of ordinary differential equations: Bassel, lagrands

Partial differential equations: Engineering applications, laplace transformations and other transform methods. Series solutions and special function and as gamma function, beta, Gauss functions, Fourier series.

ENG 308 ENGINEERING MATHEMATICS II (2,1,0)

Pre-requites: MTH 202, ENG 307

Numerical methods and digital computer methods applied to various engineering problems including matrix inversion, approximation of functions, integration, differentiation-ordinary and partial; and optimization. Applications in engineering, fast Fourier analysis, transportation and other optimization problems, dynamic programming, Monte Carlo simulation of simple engineering components and systems. Introduction to space formulation, analysis and applications.

ENG 317 ENGINEERING REPORT WRITING AND PRESENTATION (1,1,0)

Methods and formations involved in and presentation of technical reports. Current technical reports. Current techniques in engineering paper presentation. Communication schemes. Referencing and types of referencing e.g Harvard and Vancouver Methods. Use of internet research methods. Technical presentation (writing and data collection, organization and presentation). Oral presentation of technical ideas. Use of audio-visual presentation aids (multi-media, computer hardware and software

applications, etc). Use of modern software in presentation, e.g., Microsoft Power Point, Corel Draw, Microsoft Work and others.

ENS 302 ENTREPRENEURIAL STUDIES II (1,0,1)

Concept of business and new value creation, introduction to theories of growth, business strategy, , sources of capital, principles of marketing, business ethics and social responsibility, opportunity sets and expansion consideration (E-commerce, E-Business E-Trade), the scientist/engineer as an entrepreneur; opportunities and challenges, managing transition (start up, growth), basic accounting literary, feasibility and viability studies including issues in cash flow analysis. Crafting business plans. Corporate governance and change management.

Practice: Innovative solution to invention needs chosen by students. Development of new products or processes. Development of business plans and proposals.

ENG 405 ENGINEERING MANAGEMENT (1,1,0)

Engineering Professional Ethics and Conduct.

LAW: Definition and specifications: applications of business law to engineering; patents and inventions. Trademarks and copy rights; contract documents; Engineering business-types, the structure and functions of organizations; professional problems-Legal responsibilities, professional liability, role of engineers in law suits.

MANAGEMENT: Organizational structure and behavior; Engineer to engineer manager transition; management functions - principles and techniques of planning, forecasting, organizing technical activities; project selection and management; leadership, style of leadership and management. Techniques in engineering management- motivated appraisal, participative and control techniques.

CHEMICAL ENGINEERING COURSES

CHE 202 INTRODUCTION TO CHEMICAL ENGINEERING (2,1,0)

The historical development of chemical engineering and technology.

The impact of chemical engineering profession on National Development. Career opportunities for chemical engineers.

Scope of chemical engineering profession.

Flow-sheeting, including development of flow diagrams of industrial processes.

Unit operation and unit processes.

Nature of manufacturing processes for various chemicals and intermediates, give examples of industries and key products.

Useful computational techniques-Units and dimensions, conversion of units, graphical procedures, numerical techniques, etc methods of measurement and analysis; physical and chemical properties of compounds and mixtures.

Stoichiometry.

Law of conservation of mass and general material balance.

CHE 301 CHEMICAL ENGINEERING PROCESS CALCULATION (1,1,0)

Steady state material balance involving drying, mixing, vaporization distillation, phase equilibrium, absorption, extraction, chemical reaction, humidification, etc.

Re-cycle, by-pass and purge operation and calculations.

Methods of solving material balance problems e.g. Algebraic,

Computer, addition and subtraction, tie component methods, etc.,

Basic thermodynamics and thermochemistry. General heat balance

Energy balance with and without chemical reaction

Simultaneous heat and mass balance

Unsteady state heat and mass balance

Introduction to process economics

Pre-requisite: MTH 101, MTH 102 & CHE 202

CHE 302 CHEMICAL KINETICS AND REACTION ENGINEERING (2,1.0)

Classification and types of chemical reaction.

Measurement and analysis of chemical reaction.

Homogeneous and heterogeneous reaction; photochemistry

Absorption of gases on solids

Application to gases chromatography

Reaction rate, variables determining reaction rate.

Kinetics of homogeneous reactions (elementary and non-elementary)

Kinetic models for homogeneous reactions.

Rate expression from postulated mechanisms

Arrhenius equation

Interpretation of batch reaction data, integral and differential methods of analysis of reversible,

Parallel, series and autocatalytic reactions.

Variable volume reaction

Types of reactions space time and space velocity.

Size comparison of single ideal reactions for 1st and 2nd order reactions, Multiple reaction system,

Reaction cascade, recycle reactor, autocatalytic reactor and choice of reactions.

Pre-requisite: CHM 102 & MTH 203

CHE 304 CHEMICAL ENGINEERING THERMODYNAMICS (2,1,0)

Advanced topics in thermodynamic properties of homogeneous mixtures, Phase equilibria, criteria for phase rule, vapour liquid equilibra for miscible systems at low to moderate pressures, pressure-temperature-composition diagrams, bubble point, dew point, and flash calculation. Heat effects: heat effects accompanying phase changes of pure substances. Clausius-Clapeyron equation, Antoine equation, heat of reaction, heat of formation, heat effects, industrial processes, heat effects of mixing processes, enthalpy-concentration diagrams.

Chemical reaction equilibra, equilibrium conversions and compositions for gas-phase reactions.

Thermodynamic analysis of processes, calculation of ideal work and lost work. Pre-requisite: ENG 209.

CHE 307 TRANSPORT PHENOMENA I (2,1,0)

Definition of a fluid and fluid properties: Statics of fluid systems: pressure in a static fluid; Manometry, forces on plane and Curved surfaces, Buoyancy and Flotation, stability of floating and submerged bodies. Kinematics of fluid motion; types of flow, Continuity equation, Energy equation. Fluid resistance; Laminar and turbulent. Flow in closed conduits; Boundary Layer concepts.

Hydraulics of pipe Flow; Hydraulic and Energy Grade Lines, Pipes in Series, Parrallel Pipes, Branching Pipes, Network of Pipes, deterioration of Pipes. Unsteady Flow in Conduits; Water Hammer, Surge Control

Pre-requisite: Nil

CHE 308 TRANSPORT PHENOMENA II (2,1,0)

Dimensional Analysis, Buckingham equation and dynamic similarity. Boundary layer theorem. Applications-fluid measurement (venturi meters, manometers, etc.) Pump sizing and selection. Heat Transport-introduction (types of heat flow;), Conduction Fourier's law, steady and unsteady states in various geometries. Convection-natural and forced; convection heat transfer, dropwise and film-wise heat transfer from vertical and horizontal surfaces. Boiling heat transfer. Heat exchangers-types concept of log-mean Temperature Difference (LMTD), overall-heat transfer coefficient, fouling factors. Number of Transfer Units (NTU), empirical correlations. (Nuselt No, Prandt No, Reynolds analogy) Heat Exchanger Design. Radiative Heat Transfer-Mechanism of radiative heat transfer, radiation properties. (e.g. emissivity, etc.) shape factor and heat exchange between radiating surfaces.

Pre-requisite: MTH 203, ENG 209

CHE 312 SEPARATION PROCESSES 1 (3,1,0)

Humidification and water cooling, filtration. Isothermal gas absorption. Binary distillation. Leaching.

Hydrodynamics of packed and plate columns.

CHE 313 INTRODUCTION TO CHEMICAL PROCESS CONTROL I (1,0,0)

Introduction to process Dynamic analysis, models, first and second order systems. Response of first order systems. Laplace transforms, Transfer functions. Forcing functions, stability considerations. Introduction to process Control. Open and close-loop systems. Feedback and Feed-forward control. Response of process instrumentation:

Measuring instruments, control valves. Instrumentation of processes. Applications e.g. automatic control of Fractionator.

Pre-requisite: MTH 203

CHE 314 & CHE 315 COMPUTER PACKAGES 4 CHEMICAL ENGRS. 1 & II (1,0,0) AND (1,0,1)

The use of some packages e.g. Microsoft Excel, MATLAB, ASPEN PLUS, FAMLAB, HYSYS in the solution of some Chemical Engineering problems:- EOS, VLE, Chemical Rxn Equilibrium, Mass Balance with Recycles, simulation of mass – Transfer Equipment, Processes in 1D, 2D, and 3Ds.

CHE 401 SEPARATION PROCESSES II (2,1,0)

Drying of solids. Multiple effect evaporators. Crystallization. Ion-exchange, Reverse osmosis Stage-wise and continuous contact equipment.

Pre-requisite: CHE 312

CHE 403 PARTICULATE FLUID STSTEMS (2,1,0)

Particulate solids, particle characteristics, blending, mixing and classification. Motion of particles in a fluid, terminal falling velocities, motion of bubbles and drops. Flow of fluid through granular beds and packed columns;

Carman-Kozeny equation and applications, packed columns, loading and flooding. Fluidizations characteristics of fluidized systems, gas-solid systems, mass and heat transfer between fluid and particles.

Pre-requisite: ENG 209, CHE 310

CHE 405 CHEMICAL REATION ENGINEERING II (1,1,0)

Temperature and pressure effects, adiabatic operation, non-adiabatic operation, stability of reactors, non-ideal reactors, residence time distributions, model for non-ideal flow in reactors, dispersion and tanks-in-series models, heterogeneous systems, solid-catalyzed reactors, rate-controlling step, rate expression from postulated mechanisms for solid-catalyzed reactions effectiveness factor.

Pre-requisite: CHE 302

CHE 407 CHEMICAL ENGINEERING ANALYSIS (1,1,0)

Mathematical techniques for handling various chemical engineering rate problems e.g. diffusion, heat transfer technology operations. Formulation of ordinary and partial differential equations corresponding to specific physical situations and methods of solution. Regression analysis, statistical design of experiments.

Pre-requisite: MTH 211, ENG 307, ENG 308

CHE 409 CHEMICAL PROCESS SYNTHESIS AND SIMULATION (2,1,0)

The creation and assessment of alternatives, the synthesis of plausible alternatives, the structure of systems. Process specification: Process charts, block diagrams, process flow diagrams. Process Models: types, flowsheets, output from process models.

Flowsheeting: Calculation paths-Continuous flowsheets, staged processes with recycles, general serial flowsheet, non-serial flowsheet with recycles: Computer aided balance calculations (flowsheet simulation)-degrees of freedom analysis, sequential modular and equation-based simulations, commercial flowsheeting packages. Convergence and acceleration.

(Simulation of unsteady state processes)- Distillation, Chemical reactors, process control simulation.

CHE 413 CHEMICAL PROCESS DESIGN AND ECONOMICS (3,1,0)

1. Introduction to process design development
2. Design information gathering
3. Feasibility survey, process flow diagrams, block diagrams, Mass energy balance
4. Engineering, mechanical, utility and piping flowsheets
5. Specification and selection of equipment and materials
6. Design of heat transfer equipment (e.g. heat exchanger, etc)
7. Principle and equations of economic balance
8. Overall considerations in project analysis
9. Process plant components
10. Cost estimation and cash glow
11. Capital investments and their estimation
12. Total product costs, gross earnings and net profits
13. Investments and investment costs
14. Taxes and insurance
15. Depreciation and methods fro its determination
16. Profitability and investment criteria

17. Net present worth and discounted cash flow
18. Replacement of plants and equipment
19. Patentability

Pre-requisites: ENG 212 CHE 307 CHE 308

CHE 501 CHEMICAL PROCESS CONTROL II (2,1,0)

Philosophy of control:

Revision of process dynamics and transfer functions. Open and close-loop control systems. Responses of control loops. Stability of process systems-roots locus and frequency-response methods. Process control system, controllers mechanisms and modes of control. Types of controllers. Control of complex processes. Simulation of control systems.

Pre-requisite: CHE 313

CHE 503 CHEMICAL PROCESS OPTIMIZATION (2,1,0)

Definition and classification of optimization problems. The use of classical calculus. Single-variable optimization. Unconstrained optimization: linear approximation and transformation methods. Linear programming.

Application to the design and operation of chemical processes.

Pre-requisite: CHE 313, ENG 308, CHE 407

CHE 505/CHE 506 PROJECT (0,0,6)

Each student will be assigned to a department-approved research or design topics. The student liaises with his supervisor for further guidance on the content and scope of his project work. The work should begin with a bibliographic research, followed by laboratory experimental work or a technological and mechanical design of a process or part of a process plant coupled with an appropriate cost analysis.

Pre-requisite: 5th Year Standing

CHE 507/CHE 524 CHEMICAL PROCESS PLANT DESIGN II AND III (1,0,2) (0,0,2)

Design problem: Students are divided into groups and each group is assigned a process design problem. They are allowed 2 months to complete and submit the

design. The design problem is intended to be a test of the student's ability to solve practical problems similar to the ones they are likely to meet in real life.

Pre-requisitel CHE 413

CHE 508 ENVIRONMENTAL ENGINEERING (2,1,0)

Pollution and the environment-definition and interrelationships, natural and man-made pollution, the economics of pollution. Air pollution-production, emission and transfer of contaminants through the atmosphere from stationary sources. Legislation; mathematical models of air pollution. Control concepts. Theory and design of control devices. Integration of pollution control in chemical engineering processes. Current research and development in air pollution control.

Water pollution-Rivers sources/types of pollution by industrial effluents, legislation and standards for effluent discharge, wastewater treatment objectives and methods. Design of facilities for the biological treatment of wastewater. Ecology of biochemical reactors, kinetics of biochemical systems, modelling of ideal biochemical reactors, design of facilities for the biological treatment of waste water.

Land pollution-Disposal of solid wastes by incinerator and dumping, possible future trends including conversion of solid wastes into materials and energy. Noise pollution, thermal and nuclear pollutions.

CHE 509 BIOCHEMICAL ENGINEERING (2,1,0)

The structure of cells, amino acids and proteins. The kinetics of enzyme catalyzed reactions. The kinetics of substrate utilizations and biomass productions in cell cultures; transport reactors with special emphasis in fermentation systems.

Pre-requisite: CHE 301 & CHE 302

CHE 510 CHEMICAL ENGINEERING SEMINAR (0,0,1)

Student will be expected to prepare and deliver a seminar on material from recent literature or industrial experience as well as an impromptu talk on a variety of topics

Pre-requisite: Nil

CHE 511 INDUSTRIAL PROCESS PLANT OPERATIONS AND MANAGEMENT (2, 1, 0)

Process management of materials and energy – integration of processing steps and equipment on practice. Encyclopedia Review of the manufacturing processes of various heavy chemical and intermediates e.g. H_2SO_4, HCl, HNO_3, ammonia, caustic

soda/potash, soaps and detergents, cement, fertilizers, petrochemicals, pulp and paper, industrial fermentation processes and metal or processing.

CHE 512 CHEMICAL REACTION ENGINEERING III (HETEROGENOUS CATALYSIS) (3,1,0)

General definition of catalysis, catalyst formulation. Rate equation for heterogeneous reactions, fluid particles reactions, unreacted core model for spherical particles (shrinking core model), rate of reaction for shrinking spherical particles, determination of rate controlling step. Solid catalyzed reactions, experimental methods for finding rates. Fluidized bed reactors. Applications of heterogeneous catalysis to selected catalytic processes.

Pre-requisite: CHE 405

CHE 513 ENERGY CONVERSION ENGINEERING (2,1,0)

1. Fuel and energy-sources, types
2. Energy conversion-combustion and incineration, air requirements
3. Coal-composition, properties, ranking, classification, treatment, carbonization, gasification, hydrogenation
4. Petroleum-origin, production and processing, types of crude oil, cracking and refining, etc.
5. Energy transport, storage and management, environmental problems and abatement
6. Solar energy calculations, flame temperature calculations, furnace and kiln calculation, nuclear and atomic energy calculation
7. Combustion technology and aerodynamics
8. Energy statistics
9. Radioactive waste and packed radioactive waste, nuclear criticality, decontamination, neutron activation.
10. Solar flux and weather data, solar availability, solar collectors, optical and selective surfaces: direct conversion to electricity.

CHE 514 PETROCHEMICAL PROCESSES (2,1,0)

1. Petroleum-crude oil, natural gas petroleum refining operations
2. Petroleum feedstock's-cracking techniques (thermal, catalytic, hydro cracking, visbreaking and deep catalytic cracking, process description and mechanism of cracking
3. Reforming-catalytic, platinum forming, hydro forming, steam forming etc.
4. Dehydrogenation of cyclohexane, dehydrocyclization of paraffins, isomerization of butane, cycloparaffins alkylation.
5. Desulphurization

6. Sources of petrochemical hydrocarbons, associated and non-associated gasses, LPG, SR petroleum liquids, crackates, reformats and hydrocrackates.
7. Processes for the production of pure hydrocarbons, BASF flame-cracking process for acetylene, steam cracking for ethane and propane.
8. Houdry process for butadiene, dehydrogenation process for isoprene and styrene
9. BTX from catalytic reformate by SHELL-SULFOLANE solvent extraction
10. LURGI Aerosolvan process, production of styrene and cyclohexane, alkylation of bezene to various products
11. Synthesis gas production; methanol, formaldehyde and ammonia manufacture from synthesis gas. Acetaldehyde from ethane (Wacker process); the OXO processes and products.
12. Chloroprene manufacture from butadiene.

CHE 515 COAL PROCESSING TECHNOLOGY (2,1,0)

Introduction to coal formation, physical and chemical properties of coal, carbonization of coal. Gasification of coal. Liquefaction of coal. Environmental aspects of coal utilization.

CHE 516 SEPARATION PROCESSES III (2,1,0)

Solvent extraction, extractive and azeotropic distillation. Multicomponent gas absorption. Distillation of multicomponent mixtures. Novel separation processes.

CHE 518 POLYMER SCIENCE AND TECHNOLOGY (2,1,0)

Introduction to polymer and their characteristic. Sources of monomers. Structure and physical properties of polymer; rheology, solubility and molecular weight. Plasticity and elasticity. The William Landel Perry equation. Polymerization reactions and manufacturing methods; Ziegler Natta catalysis. Processing and technology of polymers.

CHE 520 PULP AND PAPER TECHNOLOGY (2,1,0)

Properties of raw materials. Preparation of pulpwood. Pulping processes. Energy recovery. Bleaching of pulps and stock preparation. Utilization of by-products economics and econological aspects of paper manufacture.

CHE 526 PINCH TECHNOLOGIES (2,1,0)

Pinch Technology and Energy Savings. Heat Exchanger, Network (HEN) representation, Location of PINCH and significance of PINCH. Design for maximum energy recovery. Minimum number of heat exchanger units; splitting of process streams, matching of process units.