MTH 123 VECTORS, GEOMETRY AND STATISTICS (3 CREDITS)

I. Vectors and coordinate: Types of vectors: points, line and relative vectors. Geometry representation of vectors in 1-3 dimensions. Addition on vectors and multiplication by a scalar. Components of vectors in 1, 3 dimensions ; direction cosines. Linear independence of vectors.Point of division of a line.Scalar and vector products of two vectors.Simple applications. Two distance between points. Equation of circle, tangent and normal to a circle.Properties of parabola, eclipse hyperbola.Straight lines and planes in space; direction cosines angle between line and between lines and planes; distance of a point from a plane; distance between two skew lines.

II. Statistics: introduction of statistics. Diagrammatic representation of descriptive data.Measures of location and dispersion for ungrouped data. Grouped distribution measures of location and dispersion for grouped data. Problems of grouping associated graphs. Introduction to probability: sample space and event, addition law,

*use of permutation and combination in evaluating product-moment and rank correlation. Linear
correlation; scatter diagram, product-moment and rank correlation. Linear regression

III. Suitability: A, B, C1, C2, D.

MTH125 DIFFERENTIAL EQUATIONS AND DYNAMICS (3 CREDITS)

1. Differential Equations: formation of differential equation of 1st order of the type. Variables, separable, exact, homogeneous and linear, differential equations of the second order with constant coefficients of the form.
2. Dynamics: resume of simple kinematics of a particle. Differentiation and integration of vectors w.r.t a scalar variable. Application of radial and transverse, normal and tangential components of velocity and acceleration of a particle moving in a plane force, momentum and laws of motion; law of conservation of linear momentum. Motion under gravity, projective.Simple cases of resisted vertical motion.Motion in a circle (horizontal and vertical).Law of conservation of angular momentum.Application of the law of conservation of energy.Work, power and energy.Description of simple harmonic motion (SHM) SHM of a particle attached to an elastic string. Description of simple harmonic motion (SHM of a particle attached to an elastic string or spring. The simple pendulum. Impulse and change in momentum. Direct impact of two smooth sphere, and of a sphere on a smooth plane.
3. Rigid body motion: moments of inertia, parallel and perpendicular axes theorems. Motion of a rigid body in plane with one point fixed, the compound pendulum. Reactions at the pivot.Pure rolling motion of a rigid body along a straight line.

CHM124: ORGANIC CHEMISTRY II (3 CREDITS)

(a) Polar functional Group Chemistry

(i) Hydroxyl group – Alcohol and phenols. Classification.Acidity-comparison.Important methods of preparation. Reactions: with metals, bases, alkyl halides. Oxidation, dehydration.Tests for alcohols and phenols, importance.

(ii) Carbonyl group – Aldehydes and ketones structure: Physical properties. Important methods of preparation. Reactions: Tollen's reagent, Fehling's solution, Benedict's solution. Iodoform reactions; with HCN NaHSO3; alcohols, including mechanisms, with ammonia, hydrazines and their derivatives, including mechanisms; aldol condensation.Tests for aldehydes and ketones.Importance.

(iii) Carboxylic group: Monocarboxylic acids. Structure.Physicalproperties.Acidity and resonance.Important methods of preparation, from alcohols, aromatic hydrocarbons, through Grignard's reagent.Reaction with bases.Conversion to esters, amides, halides and anhydrides.Tests for carboxylic acid.Importance.

(iv) Carboxylic acid derivatives: Anhydrides acid halides esters and amides. Change of reactivity when OH of acid is replaced by – Oocor – X –OR, -NR. Reaction with water, alcohols, ammonia and amines LiACH4, NaBH4, Test for esters.

(v) Amino group – Amines. Structure.Physicalproperties.Important methods of preparation.Reaction with acids.Basicity and salt formation; Alkylation, acylation, with nitrous acids.Heinseberg method of separation.Tests for amines.Importance. (b) Miscellaneous Topics

(i) Fats and oils. Definition, importance.Saponification.Soaps and detergents.Modes of cleaning action. Reaction of soap with hard water, mineral acids. Drying oils, mode of action, use in paints and varnishes.

(ii) Amino acids, Proteins: Definition, classification, essential amino acids, special properties and reactions, isoelectric point, tests. Importance.

(iii) Carbohydrates. Definition, classification, importance, nomenclature, structure and reactions of glucose.Mutoration tests.

(iv) Natural Products. Main classes (other than lipids carbohydrate and proteins); Steriods, terpenoids, alkaloids, prostaglansdens definition, importance, examples.

PHY 113 VIBRATIONS, WAVES AND OPTICS (3CREDIT)

Periodic motion of an oscillator: velocity and acceleration of a sinusoidal oscillator, equationof motion of a simple harmonic oscillator: damped oscillations; forced oscillations; resonance; propagation of longitudinal and transverse vibrations.

Wave behavior: reflection of waves, stationary waves, propagation of straight and circularpulses; fiber optics, diffraction, refraction, dispersion, interference, coherence and polarization.

Wave and light: mirrors, lenses, formation of images, thin lenses in contact, microscope, telescope: chromatic and spherical aberrations and their reduction, dispersion by prisms: relation between colour and wavelength; spectra.

GST 111 USE OF ENGLISH I (2 CREDITS)

Effective communication and writing English, study skills, language skills, writing of essays; introduction to lexis, sentence construction, outlines and paragraphs.Collection and organization of materials and logical presentation of papers.Use of the library, phonetics, public speaking and oral communication.

GST 112 PHILOSOPHY AND LOGIC(2 CREDITS)

A brief survey of the scope notions, branches, and problems of philosophy.Symbolic logic, special symbols in symbolic logic; conjunction, affirmation negation, disjunction, equivalence and conditional statements.Laws of thought the method of deduction, using rule of inference and bi-conditionals.Quantification theory.

SECOND SEMESTER 1OO LEVEL

CHM122 GENERAL CHEMISTRY II (3 CREDITS)

Acids, bases and salts.Quantitative and qualitative analysis.Theory of volumetric analysis-operations and methods. Calculations: mole, molarity. Behavior of electrolytes.Behavior of electrolytes, water colligative properties.Ostwald's dilution law.ArheniusBronsted-Lowry; Lewis concepts and applications.Buffers , introduction to reaction rates. Equilibria and equilibrium constants.Solubilityproducts.Common ion effects.Precipitation reactions.

MTH 111 ALGEBRA AND TRIGONOMETRY (3 Credits)

Real number system: simple definition of integers, rational and irrational numbers. The principle of mathematical induction.Real sequences and series; elementary notions of convergence of geometric, arithmetic and other simple series.Theory of quadratic equations. ^Simple inequalities: absolute value and the triangular inequality. Identities partial fractions.Sets and subsets, union, intersection, complements properties of some binary operations of sets; distributive, closure, associative, cumulative laws with examples, relations in a set,;equivalence relation. Properties of set functions and inverse set functions, permutations and combinations.

Binomial theorem for integer n-0 index: circular measure, trigonometric functions of angles of any magnitude. Addition and factor formulae.Complex numbers; algebra of complex numbers, the agrand diagram, De Moivre's theorem, n-throat of unity.

MTH 112 CALCULUS AND REAL ANALYSIS(3CREDITS)

Elementary functions of a single real variable and their graphs, limit and the idea of continuity. Graphs of simple functions: polynomial, rational, trigonometric, etc, rate of change tangent and normal to a curve. Differentiation: as limit of rate of change of elementary functions, product quotient, function of function rules. Implicit differentiation of trigonometric and inverse trigonometric functions and of exponential functions.Logarithmicand parametric differentiation.Use of binomial expansion for any index. Stationary values of simple functions: maxima, minima and points to inflexion, integration by substitution and by parts. Define integral: volume of revolution, area of surface of evolution. Suitability A,BV,C1,C2.

PHY 111 MECHANICS, THERMAL PHYSICS AND PROPERTIES OF MATTER (3 CREDITS)

a. Mechanics: scalars and vectors: Addition and resolution of vectors. Rectilinear motion and Newton's law of motion.Inertia mass and gravitational mass; free fall; projectile motion; deflecting forces and circular motion.Newton's law of gravitation; satellites, escape velocity.Gravitational potential; potential well; special case of circular motion.Momentum and the conservation of a momentum.Work , power energy; units. Potential energy for a gravitational field and elastic bodies; kinetic energy conservation of energy; energy stored in a rotating body. Kinetic energy in elastic collisions.

b. Thermal physics and properties of matter: Temperature, heat, work; heat capacities; second law, Carnot cycle; thermodynamic ideal gas temperature scale. Thermal conductivity; radiation; black body and energy spectrum, Stefan's law.Kinetic model of a gas: equation of state concept of diffusion, mean free path, molecular speeds, Avogadro's number behaviour of real gases. A model for a solid: interspatial forces in solids, liquids and gases: physical properties of solids. Crystalline structure: close packing, orderly arrangements, elastic deformation of an ordered structure; interference patterns and crystals.

Model for matter: surface energy and surface tension, plastic deformation; thermal and electrical properties of meals. Pre-requisite: O-level or WASC.

Faculty of Engineering

University of Benin

FIRST SEMESTER 100 LEVEL

CHM 111 GENERAL CHEMISTRY I (3 CREDITS)

Relationship of chemistry to other sciences.Atoms, subatomic particulars.Isotopes, molecules.Avogadro'snumber.Moleconcept.Dalton'stheory.Modern concepts of atomic theory.The laws of chemical combination.Relative atomic masses.Nuclear binding energy, fission and fusion. The states of matter:

1. **Gases: gas laws. The general gas equation.**
2. **Liquid and solids- introduction to lattice structure- isomorphism. Giant molecules.**
   Introduction to the periodic Table, hydrogen and hybrids chemistry of groups 0, 1, 11 elements.Acid-base properties of oxides.
   CHM 113 ORGANIC CHEMISTRY I (3CREDIT)
   (a). General principles of organic chemistry.
   I. Introduction: definition of organic chemistry. Classification of organic compounds.Homologousseries.Functional groups.
   II. General procedures for isolation and purification of organic compounds.
   III. Determination of structure of organic compounds. Elemental analysis percentage composition, empirical and molecular formula, structural formula.
   IV. Isomerism, structural isomerism and stereo isomerism.
   V. Electronic theory in organic chemistry. Atomic models, quantum numbers, atomic orbital. Hybridization leading to formation of carbon, carbon single, double and triple bond. Hydrogen bounding, electro negativity, dipola moment, polarisation, bond energy, inductive and resonance effects.
   (b). Non-polar Functional Group Chemistry
   I. Alkanes: structure and physical properties. Substitution actions includingmechanism:
   II.Alkenes: structure and physical properties. Reaction: addition (of H2 X2 HX, H2O, 03), etc; oxidation polymerization. Stereo isomerism- definition, geometrical and optical isomers, conditions for optical isomerism.
   III. Alkynes, structure. Acidity of acetylenic hydrogen. Reaction: addition of H2, X2,HX, H2, FI2, O, etc. Test for Akynes,
   IV. Benzene. Structure and aromaticity of benzene.Introduction to electrophilic substitution reactions.C. Nomenclature: common (trivial) names, IUPAC names of classes of compound

PRE572: ENGINEERING MANAGEMENT II (For Non-Production Engineering Students)(3 CREDITS)

Resource Management: Materials Management. Purchasing Methods. Contracts. Stores and Inventory Control. Time Value of Money, Interest formulae. Rate of Return. Methods of Economic Evaluation. Selection between Alternatives.

Planning Decision-Making Forecasting, planning, scheduling. Production control. Gantt Chart. C.P.M. and PERT.

Optimisation. Linear programming as an aid to decision-making. Elementary treatment of decision-making policies under risks and uncertainties.

Transport and Materials Handling Selection of transport media for finished goods, raw materials and equipment. Facility layout and location.

Basic principles of work-study. Principles of motion economy. Ergonomics in the design of equipment and process. Maintenance Engineering

PEE572: OIL AND GAS PRODUCTION TECHNOLOGY III (3CREDITS)

Surface production operations. Review of well heads and X-mas tree; Types of valves and pressure regulators. Separation of Oil and Gas – Basic mechanism: Equilibrium calculations. Factors affecting separator performance – (Pressure, Temperature, Stage, separation, composition) Types of separators (spherical, vertical and horizontal) (cyclone, 3-phase, auto-metering, etc.). Selection of separator type. Oil storage tanks and gauges. Oil and Gas gathering systems. Transportation of oil isothermal and non- isothermal flow. Calculation of head loss for the steady state flow of a Newtonian oil (Chernikin's Theory and Ford's Theory). Start up pressure of oils. Improvement of flow characteristics.

PEE582: NATURAL GAS ENGINEERING II (PROCESSING) (3 CREDITS)

What is Natural Gas Processing? "Gas to Wealth": Gas to Wealth: Definitions of Wealth; Assets, etc. Natural Gas and the Possible Effluents at the Surface, why do we Process Natural Gas, Processing Points/Vessels at the Surface, Natural Gas and Water Systems. Phase Behavior of Natural Gas/HC and NG/Water Systems, Wellhead Conditions and Processing of NG Systems, Effluents Entry into Separator Vessels – P, V, T Conditions, Separators: Types, Phase and Stage Separation, Flash Behavior and Calculations, Bubble Point and Dew Point Definitions and Determinations. Processing of Natural Gas Systems: "Vapor Derivatives", De-hydration of the Natural Gas Systems, Dew Point Depression, Hydrates, Inert Gases, Acidic Gases; Sour Gases, Scrubbing of Processed Natural Gas Systems, Key factors that drive Process Vessels. Fractionation of Processed Natural Gas Systems, Definition of Fractionation of Natural Gas Systems, Natural Gas Liquids Extraction (NGLs). Monetization of Natural Gas: LNG Asset/group, Gas to Power Assets/group, Petrochemicals Assets/group, Other Gas Assets/group, Factors that affect Monetization of Natural Gas. Compressors and Transportation of Natural Gas, Optimization Scenarios of Natural Gas Systems, Modeling Scenarios, Sizing of Facilities and Type Networks.

PEE592: RESERVOIR SIMULATION II (3 CREDITS)

Types of reservoirs and appropriate conditions; Objectives of reservoir modelling; Review of partial differential equations for reservoir models; Finite Difference Methods; Concepts of Static and Dynamic modelling; Introduction to Productivity tools – MBAL, Prosper, Saphir, Eclipse, Power log etc.; Case Studies.

PEE562: RESERVOIR ENGINEERING III (3CREDITS)

Oil Field Development. Gas Field Development, (Volumetric, water drive, Gas-condensate reservoirs) Introduction to additional and secondary recovery and its definition, different methods, mobility ratio, basic flooding networks used in industry, effect of mobility, sweep efficiency etc. Injection rate and pressures in secondary recovery. Water source and its treatment, water flooding calculations using different methods – spacing and row of the wells. Immiscible and miscible displacement processes polymer flooding, Thermal recovery methods. Economics of the oil and gas reservoir. Evaluation and Feasibility Studies.

PEE581: NATURAL GAS ENGINEERING I(SUBSURFACE) (3 CREDITS)

What is Natural Gas? Definition of Petroleum, Definition of Natural Gas/Natural Gas Industry, Sources of Natural Gas, Categories of Natural Gas, Classifications of Natural Gas. Phase Behavior (of Natural Gas), Ideal/Real Gas Laws, Properties of Natural Gas, PVT Diagrams. Reservoir Engineering Aspects of Natural Gas: What is a Natural Gas Reservoir, Types of Natural Gas Reservoirs, Volumetric Driven Natural Gas Reservoirs, Water Driven Natural Gas Reservoirs, Key factors that drive Natural Gas in the Reservoir, Pressure System(s) in a Natural Gas Reservoir, Equation(s) for Natural Gas Systems in the Reservoir, Deliverability Equation(s). Well Engineering Aspects of Natural Gas, Definition of a Natural Gas Well, Types of a Natural Gas Well, Vertical and Directional: Factors that affect Flow of Natural Gas in the Well, Pressure Profiles in Natural Gas Wells, Equation(s) for Natural Gas System(s) in Wells, Optimization Scenarios of Natural Gas Production, Modeling Scenarios, Sizing of Facilities/Trouble Shooting, Possible Effluents at the Surface

PEE591: RESERVOIR SIMULATION I (3 CREDITS)

Review of relevant concepts and equations for reservoir performance studies; Concepts of ordinary and partial deferential equations in reservoir studies; Analytical solution methods; Numerical solution methods – Taylor Series, Zeros of a Function, Numerical Integration, etc.; Introduction to computational studies.

PRE571: ENGINEERING ECONOMICS AND ADMINISTRATION (3CREDITS)

The Management Environment-Formation of a company, sources of finance, money and credits. Insurance, National policies, GNP growth rate and prediction. Balance of payments. Letal liabilities under company law, legal and contractual obligations to employees and the public, contractual obligations. Organizational Management- Principles of organization, span of control. Elements of organization. Types. Principles of management. Schools of thought. Management by objectives. Financial Management- Accounting methods. financial statement. elements of costing. cost planning and control. budget and budgetary control. Cost reduction programmes. Personnel Management- Selection, recruitment and training. Job evaluation. Merit rating. Incentive schemes. Trade unions and collective bargaining. Industrial Psychology- Individual and group Behaviour. The learning processes. Motivation and morale. Influence of the Industrial Environment.

PEE532: FIELD DEVELOPMENT PLAN (S) (3 CREDITS)

General Overview of field development: (i). Definition and importance of FDP(ii) other Definitions-Exploration, Appraisal, development, production, surface operations and field abandonment. (iii). Phases of Field development: Analytical, Modeling and Forecasting

Exploration and Appraisal: (i). Exploration evaluation and drilling techniques (ii) Log evaluation (iii) Mapping and volumetric (iv) Risk and uncertainty analysis using Monte Carlo analysis (v) Appraisal methods and value of information Subsurface and surface development planning (vi). Selecting drive mechanisms. Generating and evaluating options: (i). Well design (ii) Production forecasting (iii). Selecting, sizing and costing facilities. Economic analysis of options: Run project economics using spreadsheets. Process design for surface facilities: Designing the process. Bringing the field to production: Production development strategy ii. well sequencing Managing production and well intervention :(i) Managing production decline; – well workovers, facilities maintenance (ii). Identifying and evaluating near-field opportunities- development plan for satellite field development (iii) Integrated exercise using actual /hypothetical case studies – economic evaluation of incremental projects.

PEE561: RESERVOIR ENGINEERING II (3CREDITS)

Differential equation for fluid flow through porous media. Estimation of oil and gas in place, recoverable reserves by different methods; categorization of reserves. Derivation of material balance equation and production performance for different types of reservoir such as solution gas drive, water drive, gas cap drive, gas cap drive etc.; Water influx calculation, Reservoir models. Statistics and interpretation of production Data (Production of oil, water and gas, GOR, porosity, permeability).

PEE571: OIL AND GAS PRODUCTION TECHNOLOGY II (3CREDITS)

Artificial Lift Methods,

Introduction (Gas Lift Method, Sucker-rod Pumping, Rodless Pumping). Gas Lift-Basic Concept, (Continuous Flow Gas Lift, Intermittent gas lift, plunger lift). Selecting. Optimum Tubing size and design of tubing string (Fixed rate of oil and minimum gas requirement; oil flow rate and given gas consumption. Maximum feasible liquid production), Gas – Life Valves and Valve spacing (operation and dimension, unloading a well, valve depths and choke sizes). Injection gas supply, plunger lift).

Bottom-Hole Pump Production

Sucker – rod pumps, (Wellhead, surface and sub-surface equipment). Rod string, rod load, string design, effective plunger stroke, buckling of tubing. Operating points (Production Capacity, volumetric efficiency, maximum liquid production, minimum polished head. Pumping units. Rodless bottom hole pumps (Hydraulic pumps, electric centrifugal pumps and other types). Automatic controls and Interpretation of Data production economics – Optimum economical operation techniques and optimum sizes of production equipment in the case of flowing production, and artificial lift production.

Choice of most economic production methods.

PEE531: PETROLEUM ECONOMICS (3CREDITS)

A review on decision methods: payback period, discounted cash flow, Internal rate of return, e.t.c. Applications of Probability Distributions, Binomial and Normal Distributions Arrivals, Rate occurrences and Services requirements. Multiple kinds of objects and economic outcomes. Appraisal of uncertain ventures; Statistical appraisal method for several ventures. Uncertainty and Risk Analysis: Decision Trees and Economic models: Analysis of a probability tree. Comparing Alternatives; retaining partial working interest versus overriding royal interest. Evaluating acceptance of a farm-out. Stochastic decision trees forecasting and planning. Evaluation of future production by performance trends: Decline curves, theoretical relations. Simulation – the Monte Carlo Method. Petroleum Fiscal Arrangement and their economic models: production sharing Contract, Joint venture, e.t.c. Fiscal Cost analysis: CAPEX, OPEX. How does cost influence the oil and gas industry and its project: Understand the scope and structure of the industry? Projects and programmes management. The difference between value engineering and cost reduction. Basis for project planning, cost estimation and techniques. Cost Data Management: Cost modeling process, benchmarking. Construct parametric log – log charts using regression analysis.

PEE451: WELL LOGGING & INTERPRETATION (3 CREDITS)

Fundamentals: A review of petrophysical physical parameters, Invasion process, Resistivity of formation water Mud, Mud-cake and mud-filtrate; Effect of salinity on Resistivity Formation factor, porosity and lithology. Formation resistivity and saturation. Resistivity and fluid distribution Apparent resistivity. Bole hole environment

Electrical Well logs: the spontaneous potential log, Conventional resistivity logging, Induction Logging. Laterolog, Microlog, Microlaterolog. Use and Interpretation of Electrical logs (Bed detection and definition, correlation, investigation of porosity, investigation of fluid content & contact, quantitative interpretation.

Radioactivity well logging -Basic Principles, gamma ray well logging, density log, PEF log, neutron well logging, Interpretation of radioactivity logs (identification of borehole effects, formation identification, investigation of fluid contact, fluid and porosity estimation, e.t.c)

Miscellaneous well logs –Sonic log, caliper log, dipmeter log, mud log, Drill-time log, production log geologic-sample log, Cement bond log, temperature log, collar – located log, e.t.c

Crossplots- Neutron-density, Density-sonic, Sonic-Neutron, M-N Crossplots etc. for lithology and porosity determination. Hydrocarbon In-place estimation

PEE441: OFFSHORE TECHNOLOGY (3CREDITS)

Well completion and safely techniques used in Drilling and completion operations. Offshore Drilling; storage and transportation problems, prediction of wind, wave and current forces, equipment employed in marine environment. Types of offshore Drilling Rigs

- **The Operational Environment: Stability and Motion, Prediction of wind, wave and current forces, spread mooring systems, dynamic positioning of floating vessels.**
- **Offshore drilling rig equipment: Rig floor equipment, motion compensation and marine riser systems, subsea wellhead, guide base and BOP Systems.**
- **Drilling Operation Sequence in Offshore Environment;**
- **Offshore Well Control Operations;**
- **Subsea well Completions;**
- **Subsea Production Systems.**

PEE471: OIL AND GAS PRODUCTION TECHNOLOGY I (3CREDITS)

Completion of Oil and Gas Wells – single and multiple completion; open holes, Perforation Methods. Interval Selection. Productivity Consideration.

Well Head and Bottom Hole Equipment – Check and starting up of oil and gas wells.

Well Surveillance – Diagnosis, well-bore Damage (Drawdown and Build-up).

Production Logging.

Critical Completion Conditions – Sizing of Tubular Goods.

Forum on Tubing and Packers (Anchored and unanchored Tubing, Helical Buckling).

Wire-Line Operations

Workover Techniques – Perforating, Depth Control, Squeeze Cementing. Well

Treatments (Acidizing, Fracturing, Sand Control).

Fundamentals of Vertical Flow for Multiphase, System (Krislov'sPoettmann and Carpenter, Gilbert's Ros's and other theories). Single and two-phase flow through a choke. Flowing oil wells. Types and control of flowing wells.

CHE411: PETROLEUM REFINERY PROCESSES (3CREDITS)

Refinery Flow Sheet: Overall Refinery Operations, Terminology, Storage, Interrelationship of Processes.

Feed Stocks: Chemistry, Properties and Types of Crude Oils, Effects of Properties on Refinery Operation. Refinery products: motor fuels, heating oils, lubricating oils, petrochemical feed stocks, etc. specifications on refinery products. Crude oil processing: desalting, atmospheric and vacuum distillation. Processes for motor fuel yields: Reforming, catalytic cracking, hydrocracking, alkylation polymerization and isomerization. Calculation of product yield from these processes. Use of commercial software for calculation of yield from refinery processes. Product blending to meet specification. Octane, cetane, flash point and viscosity blending. Sulphur removal and recovery in refineries processing crudes. Water and air pollution control.

PEE401: PETROLEUM ENGINEERING LABORATORY (2CREDITS)

Drilling Practices, Core Analysis, PVT Analysis.

ELA302 LABORATORY/WORKSHOP PRACTICE I (2CREDITS)

Laboratory hours are utilized as follows:

1. Mechanical Engineering Laboratory

(a) Thermodynamics

(b) Mechanics

3. Petroleum Engineering Laboratory/Workshop Practices

(a) Mud Engineering

(b) Reservoir Engineering

(b) PVT Analysis

400 LEVEL PETROLEUM ENGINEERING

PEE451: WELL LOGGING & INTERPRETATION (3 CREDITS)

Fundamentals: A review of petrophysical physical parameters, Invasion process, Resistivity of formation water Mud, Mud-cake and mud-filtrate; Effect of salinity on Resistivity Formation factor, porosity and lithology. Formation resistivity and saturation. Resistivity and fluid distribution Apparent resistivity. Bole hole environment

Electrical Well logs: the spontaneous potential log, Conventional resistivity logging, Induction Logging. Laterolog, Microlog, Microlaterolog. Use and Interpretation of Electrical logs (Bed detection and definition, correlation, investigation of porosity, investigation of fluid content & contact, quantitative interpretation.

Radioactivity well logging -Basic Principles, gamma ray well logging, density log, PEF log, neutron well logging, Interpretation of radioactivity logs (identification of borehole effects, formation identification, investigation of fluid contact, fluid and porosity estimation, e.t.c)

Miscellaneous well logs –Sonic log, caliper log, dipmeter log, mud log, Drill-time log, production log geologic-sample log, Cement bond log, temperature log, collar – located log, e.t.c

Crossplots- Neutron-density, Density-sonic, Sonic-Neutron, M-N Crossplots etc. for lithology and porosity determination. Hydrocarbon In-place estimation

PEE461: RESERVOIR ENGINEERING I (3CREDITS)

Introduction to Petroleum Reservoir Engineering, Physical Properties of rocks and fluids (porosity, permeability – effective and relative permeability, specific surface of rocks, compressibility of rock and fluids, fluid saturation, wettability, surface tension, capillary forces, etc.). Fluid flow through porous media – Application of Darcy Law. Reservoir drives and races. Hydrocarbon content of reservoirs; its composition; formatting. Water and its Physical Properties. Gas behavior, basic concept of phase Behaviour of hydrocarbon systems such as single, binary and multi-components systems. Equilibrium constant and its application. Sampling for PVT analysis, other methods of determining reservoir fluid properties, evaluation and interpretation.

EMA481: ENGINEERING MATHEMATICS V (3CREDITS)

1. Complex variables: Complex functions of a real variable. Elementary functions of a complex variable. Differentiation of a complex variable. Cauchy-Riemann equations. Analytic and Harmonic functions. Integration of complex variables. Cauchy's theorem, poles and residues. Simple examples of expansion in Taylor and Laurent series. Conformal mappings.
2. Integral Transforms: Laplace and Fourier Transforms. Application to Boundary value Problems in Mathematical Physics.
3. Introduction to non-linear Differential Equations:
4. Stability of linear systems and the phase portraits
5. Long time Behaviour of the solution of non-linear differential equations deduced from related linear systems.
6. Calculus of Variations: Lagrange's equation and applications. Hamilton's principle and Geodesic problems (formal proofs of the related theorems will not be required).

Iso-perimetric problems.

1. Probability: Probability Laws, conditional probability and dependence of events. Discrete and continuous probability distribution. The probability function; the density function and the distribution function. Expected values, moments, standard distribution, Binomial, Poison and normal.
2. Statistics: Regression and Correlation; total, partial and multiple. Large sampling Theory: Sampling distribution of mean, proportion, difference of two means and proportion. Confidence intervals for mean, proportion, difference of two means and proportions.
3. Test of Hypotheses: types I and II errors. Power of a test. Large sample test concerning the mean, proportion, difference of two means and proportions.
4. Quality control.

PEE431: WELL TESING & ANALYSIS II (3 CREDITS)

Fractured reservoirs; Flow behavior; fracture detection; conventional evaluation; type curves. Injection Well Testing; (Fall of analysis, injectivity test, step rate test). Testing Methods; drill stem testing, interference testing. Pulse testing; pulse testing, SFT.Other equipment.

Gas well testing. Further type-curve matching. Elementary horizontal well testing and analysis.

CVE 311: STRENGTH OF MATERIALS (3 CREDITS)

(I) Advanced topics in bending moment and shear force in beams.

(II) Theory of bending of beams. Deflections of beams. Unsymmetrical bending and shear Centre. Applications. Strain energy.

(III) Biaxial and triaxial states of stress. Transformation of stresses. Mohr's circle. Failure theories.

(IV) Springs.

(V) Creep, fatigue, fracture and stress concentration.

PRE311: MANUFACTURING TECHNOLOGY III (3 CREDITS)

(For Non–Production Engineering Students)

Working principles, size and specification, classification, principal parts, work–holding and driving mechanisms of shaping, slotting, planing machines, turret and capstan lathes. Applications of automatic and semi–automatic lathes. Milling operations and machines: types, cutters, attachments, direct and simple indexing. Grinding machines and wheels: wheel characteristics, selection, specification, etc. Various methods of grinding processes, speed and feed applied. Welding of ferrous/non–ferrous metals and alloys, cast iron. Uses of brazing and soldering. Plastic and powder metallurgy. Basic principles of pattern, mould, core making: their materials, allowances, etc. Metal melting and casting.

CHE331: TECHNICAL REPORT WRITING AND COMMUNICATION (2 CREDITS)

Principles of communication. Parts of technical reports: Introduction, Abstract, Main body, Conclusions and Recommendations, Tables, Figures, Graphs and Illustrations, References, Appendices. Writing the first draft. Revising the first draft: Content and Structure. Audiences, Scientific and Technical prose: Spelling and Scientific terminology. Using numbers and symbols.

Data: Statistical analysis of data and display. Software support for various writing and graphic tasks. Use of Microsoft power point. Preparation of curricula vitae, research grant proposals, short talks and posters and feasibility report. Writing a thesis.

PEE322: PETROLEUM GEOLOGY (4 CREDITS)

Elements of Geology:Revisions: Geology and Petroleum, Geology of Petroleum, Origin, Migration, Accumulation, Recovery, Geologic Time Scale: Age of the Earth, Depositional Processes and Environments, Geologic Basins and Rocks, Structural Geology, Stratigraphy, Sedimentary Rocks:Texture, Structure and Composition of Rocks, Source Rocks, Origin and Migration of Petroleum, Traps and Seals: Definitions and Classifications, Reservoir Rocks, Accumulation of Petroleum, Necessary and Sufficient Conditions for Accumulation of Petroleum, Properties of Sedimentary Rocks. Exploration for Sedimentary Rocks:Surface Geologic Methods, Geo-physical Methods for Subsurface Exploration, Drilling and Formation Evaluation Methods. Map Elaboration:Facies and Facies maps, Cross sectional Analysis; Profiles Construction, Planimeter Method, Structural Maps; Iso-pach, Iso-baric Maps. Resources Volumes and Reserves: Types of Resources in Place, Conditions of Existence, Initial Volumes in Place, Reserves. Recovery and Recovery Mechanisms: Primary Energy, Supplementary Energy. Petroleum Geology of Nigeria, Stratigraphy, Major Basins in Nigeria, Producing Basins and Geology.

PEE332: COMPUTER APPLICATIONS IN PETROLEUM ENGINEERING (3CREDITS)

Introduction to computers and programming languages; Areas of Petroleum Engineering requiring computer applications; The FORTRAN Programming language; Applications of FORTRAN Language to Petroleum Engineering problems – perform decline curve analysis and P/Z analysis, create wellbore schematics, optimize gas wells and gas gathering systems; use hydrocarbon process simulation software to predict properties of natural gas and simulate gas processing operations. Use of other programming languages such VB, Java.

PEE342: DRILLING TECHNOLOGY II (3 CREDITS)

Formation Damage, Lost Circulation, Stuck pipe, Fishing Operations. Causes, Control and Prevention; Well Control – Causes and Detection of Kicks, Well Control Procedures, Kill Calculations. Blowout (causes, control and prevention including equipment used). Casing and Casing string Design – Functions and Types of Casings, Planning a casing program, casing selection and Design, Runnings, casing Landing Procedures; Cementing Operations – Functions of Cementing, types and properties of cements/additives, primary cementing operations including mud. Hole and pipe preparation, equipment (surface and downhole) used in primary cementing operations, operational techniques and evaluation, squeeze cementing, open-hole and casing plugs, etc. Workover Operations – Introduction, Workover Techniques (Perforating, Depth Control, Squeeze Cementing, well Stimulation); Sand Control; Directional Drilling; Optimizations of Drilling Operations; Drilling in Niger Delta.

MEE 352: THERMODYNAMICS II (2 CREDITS)

Thermodynamic Properties of Pure Substances: Properties of ideal and real gases, kinetic theory of gases. Mixtures: mixtures of perfect gases, mixture of gas and saturated vapour psychometry applications. Power Transfer System: introduction to vapour power cycles, Rankine cycle with reheat. Second Law Topics: Gibbs and Helmholtz free energies. Irreversibility and availability, principle of maximum work, thermodynamics potentials.

MEE 332: STRENGTH OF MATERIALS I (2 CREDITS)

Shear stresses and strains in beams, horizontal shear force in wide flange beams. Shear center. Bending of beams of varying cross-section. Beams of uniform strength. Bending of compound and composite beams. Simple reinforced concrete beams. Strain energy in bending unsymmetrical bending. Deflection of Beams: Differential equation of elastic line. Double integration, area-moment and superposition methods. Introduction to energy methods. Deflection due to shear. Biaxial Stresses: Stresses on an oblique plane. Two-dimensional transformation equations. Concepts of principal stresses and principal planes. Mohr's circle. Principal strains, relation between elastic constants. Application to this walled pressure vessels. Theories of Failure: Maximum principal stress, maximum shear stress and other theories of failure. Strings: Open coil and close helical springs. Lead springs.

EMA 382 ENGINEERING MATHEMATICS IV (3 CREDITS)

1. **Fourier series: periodic functions. Euler formula for coefficient in Fourier sine/cosine series of a function.Even and odd functions and their Fourier series. Half range expansion. Theoretical basis of Fourier series.Application to the solution of partial differential equations.**
2. **Gamma, beta and probability function (emphasis rather on the applications)**
3. **Differential equation: equations of the form $y'' = f(X,Y')$. Linear second order equations reducible to linear equation with constant coefficients. Series solution of differential equation.Legendre's differential equation and Legendre polynomials.Bessel's differential equation and Bessel functions of first kind; their properties and introduction to application.**
4. **Vector Field Theorem. Scalar and vector fields; directional derivative; gradient of a scalar field; divergence and curl of a vector field; del operator. Line, surface and volume integrals independent of path and irrational vector.**

CVE 341 ENGINEERING GEOLOGY (3 CREDITS)

i. Introduction: definition, scope and subdivision of geology, aspects of geology and their relevance to Agricultural Engineering. Brief discussion on the origin and evolution of the planets, the earth and its relation to the sun, and other planets.

ii. Structure and composition of the earth:- The core, the mantle and the crust composition of the various layers, Radioactivity and magnetism of some rocks and minerals

iii. Geological processes: exogenicprocesses (wreathing and erosion), endogenic processes. (Magma, its origin, crystallization, differential and solidification into rocks,-earthquakes volcanoes, rifting and continental drifts),

iv. Geological processes: Folding, faulting, jointing and rifting Isostasy, changes in eustatics seal levels, causes and effects: transgression and regression, tectonic and sedimentation,

v. Fieldwork and coursework.

EMA 381 ENGINEERING MATHEMATICS III (3 CREDITS)

13. Linear Algebra: n-dimensional vectors, addition and scalar multiplication. Linear dependence and independence of set vectors.Matrices; operations of addition, scalar multiplication and product; determinants and their properties; sub matrices and rank; inverse of a matrix.Theory of a system of linear equations, linear transformation and matrices, Eigenvalue and eigenvectors of a matrix; Eigen values of Hermitian and unitary matrices.
14. Analytical geometry: plane polar coordinate, coordinate transformation. Solid geometry and spheres and quadric surface.Spherical polar and cylindrical polar coordinates.
15. Functions of several variables: mean value theorem for function of several variables, maxima and minima. Differentiation under the sign of integration.Jacobians.
16. Numerical analysis: numerical differentiation and quadratic formulae. Analytic and numerical solution of ordinary differential equations. Curve fitting and least squares. Further on linear programming(simplex method).

MEE 351 THERMODYNAMICS I (2 CREDITS)

Systems, stages, property, interactions, equilibrium, cycle, point and path functions temperature, etc. Thermodynamic Properties of Pure Substances: Perfect gas, specific and latent heats, equations of state. Phases of pure substances – solids, liquids and gases. Phases Equilibria and changes in critical point, properties of vapours, use of thermodynamics tables. Heat and Work Transfer: First law of thermodynamics, general energy equation and Bernoulli's equation. Engine cycles, air- standard cycle, Otto-cycle, simple gas turbine cycle, Carnot cycle, heat pump, etc.Second law of thermodynamics, entropy irreversibility.

MEE 361 FLUID MECHANICS I (2 CREDITS)

Fundamental notion and definitions: continuum property, density, pressure, specific volume,surface tension, viscous compressibility, etc. fluid statics: hydrostatic forces on submergedsurfaces in incompressible fluid, pressure variation in static fluids, floatation, stabilityconsiderations of floating bodies. Dynamics of fluid flow: systems and control volumeapproach to the basics and subsidiary laws for continuous media leading to the developmentof conservation equations of mass and momentum. Euler's equation, Bernoulli's equation. Introduction to incompressible viscous flow: flow of Newtonian fluids in pipes-pressure dropand shear stress in pipe flows, velocity distribution, Reynolds number and its significance. Dimensional Analysis: philosophy of dimensional analysis in engineering, dimensionalhomogeneity, similitude, Bauchingams's Pi-Theorem, important dimensionless groups inengineering. Flow measurements: flow meters and flow measurement, head flow meters inclosed and open conduits mechanical and electromagnetic flow meters, scale errors in flowmeasurement.

PEE211: BASIC PETROLEUM ENGINEERING (2 CREDITS)

Definition of Energy: Why Energy, Sources of Energy, Types of Energy, what is Engineering. The Petroleum Industry: Sectors of the Petroleum Industry, Definition of Petroleum, Phases of Petroleum, Phase Behaviour – PVT Relationship(s), Geology of Petroleum: Origin (Generation), Migration &Accumulation of Petroleum. Rocks: Formations, Reservoirs, Properties of Rocks (Sedimentary Rocks), Petroleum Environments. Subsurface Activities:The Search for Petroleum, Geo-systems Engineering, Well Construction, Well tests, Facilities, Equipment, downhole. Reservoir Engineering:What is Reservoir Engineering, Objectives of Reservoir Engineering, Reservoir Forensics. Completions:Sub-surface, Surface, Perforations (methods), Sand management Solutions. Production Engineering:Well head System(s), Surface Facilities, Equipment, Functions of Production Engineering. Field Development:Definition of a Field, what is Field Development, Tools in Field Development, Challenges in Field Development.

CHE212 INTRODUCTION TO CHEMICAL ENGINEERING II (2 CREDITS)

Fundamental of Material Balances, Process Classification, Material Balances Calculations, Recycles and Bypass, Balances of Reactive Processes, Combustion Reactions, Some Additional Consideration about Chemical Processes (Separation Techniques), Fundamentals of Energy Balances, Forms of Energy: The first Law of Thermodynamics, Kinetic and Potential Energy, Energy Balances and Closed System, Energy Balances on Open System at Steady State, Tables of Thermodynamic Data, Energy Balance Procedures, Introduction to Process Flow sheeting.

Colligative properties: Boiling point, vapor, Pressure lowering, elevation, freezing point, depression, osmotic pressure, molecular weight determination of colligative properties.

Phase equilibria: Phase rule, phase diagrams cooling curves and fractional distillation.

MATERIAL SCIENCE (3 CREDITS)

A topic Structure: Review of atomic structure and bonding in materials. Atomic and molecular structure, molecular, crystals and amorphous structure. The metallic state, Defects in crystals, Electronic structures and processes (conductors, semi-conductors and insulators). Alloy Theory: A simplified introduction to alloy theory illustrated by the Pb-Sn and Fe-C system. Application to industrially important alloys.

Engineering Properties of Materials: engineering properties of materials and their control through changes in structure (Hot and Cold-Working of metals, heat-treatment of steel, annealing, etc.). Failure of metals (Creep, fracture and fatigue). Corrosion and corrosion control.

Non-Metallic Materials: Non-metallic materials and their properties (glass, natural and synthetic rubber, plastics, ceramics and wood).

MEE 212 ENGINEERING MECHANICS II (3 CREDITS)

Position, reference frames and coordinates. Types of coordinates, scalar and vector functions,functiondifferentiation.Derivatives of vectors and moving references, frames, velocities andaccelerations relative motion.

Kinetics of rigid bodies: translation and rotation about a fixed axis for rigid bodies, general two dimensional motion of rigid bodies, vectorial and non-vectorial techniques, impulse, momentum, energy methods, moment of inertia, equivalent mass and moment of inertia simple cases of equivalent dynamic systems. Kinematics of simple harmonic motion.Simpleharmonic motion.

MEE 222 ENGINEERING DRAWING II (3 CREDITS)

First and third angle orthographic projections of complex objects.Axonometricprojectionand their basic typesigometry.Construction of cycloid, prism, pyramid, circle, long cylinderinisometry.Construction of isometric views for three and two orthographic projections of anobject.Free hand drawing. Development of surfaces curves of intersection. Interpenetrationsolids.Basic mechanical engineering drawing.Basic civil engineering drawings includingtopographical, geological structural and architectural.Basic wiring drawings, electroniccomponents circuits.

PRE 212 MANUFACTURING TECHNOLOGY II (2 CREDITS)

Simple metal cutting applied to hand tools. Single point tool geometry.Cutting fluid general principles of working of standard m etal cutting machine tools.Work and tool movement, speed and feed range.Centre lathe operations: straight/tape turning. Thread cutting. Parts of lathes accessories and attachments used on centrelathe.Drilling machine, drill bits and uses.Production of pig iron, wrought iron, plain carbon "and alloy steel and cast iron.

FIRST SEMESTER 300 LEVEL

CHE 222MATERIALS SCIENCE (3 CREDITS)

Atomic structure: review of structure and bonding of materials. Atomic and molecular structure (molecular, crystal and amorphous structure).Themetallic.Defects in crystals.Electronic structures and processes (conductors, semi-conductors and insulators).Alloy theory: a simplified introduction to allow theory illustrated by the Pb-Sn and Fe-C system. Application to industrially important alloys.

Engineering properties of materials: engineering properties of material and their treatment of material and their control through changes in structure (Hot and cold-working of metals, heat-treatment of steel, annealing, etc).Failure of metals (creep, fracture and fatigue). Corrosion and corrosion control.

Non-metallic materials: Non-metallic materials and their properties (glass, natural and synthetic rubber, plastics, ceramics and wood).

EMA 282 ENGINEERING MATHEMATICS II(4 CREDITS)

9. Further integrations: reduction formulae.
10. Differential Equations

    a. General Review. Exact differential equations. Simple applications in geometry, mechanics chemical reactions and heat flow,

    b. Second order linear differential equation with constant coefficients. Further D-operator method. Solution of second order. Differential equations by method of change of variables. Introduction to partial differential equations (separation of variables).
11. Mechanical and electrical Oscillations of damped and un-damped mechanical systems. Electrical circuit theory.Resonance.
12. Numerical methods: introduction to numerical computations. Solution of non-linear equations-both direct and iterative schemes.Finite difference operators. Introduction to linear programming (Graphical solution)

MEE 211 ENGINEERING MECHANICS I (3 CREDITS)

Mechanics , fundamental quantities of mechanics. Division of mechanics, coordinates anddimension in a space problem solving. Vector ,system of forces and couples. Rigid bodiesandequilibrium.Distributedforces.Structures and machines.Friction.Moments and productofinertia.Work and virtual work.

MEE 221 ENGINEERING DRAWING I (3 Credits)

Introduction.Geometricalconstructions.Principles of tangency.Construction of slopes.Tapers and gradients.Fundamentals of descriptive geometry and projection drawing.Central, parallel, azonometricand orthographic projections.Projections of points, lines, plane figures and simple objects.Truelengths.Orthographic projections of simple geometrical solids.Cylinder, cone, pyramid, prism, sphere, hemisphere.Popus I and II, Ring. Drawing of three orthographic projections in first angle from the isometric views of a detail. Non-circular curves. Construction of an ellipse, parabola, hyperbole, sinusoid, spiral of Archimedes, involute, cyclod, epirydoid, hypcycloid.

7. Mechanical and electrical oscillations of damped and undamped mechanical systems. Electrical circuit theory.Resonances.
8. Numerical Methods: introduction to numerical computations. Solution of non-linear equations.Solution of simultaneous linear equations-both direct and iterative schemes.Finite difference operators. Introduction to linear programming (GraphicalSolution).

PRE 211 MANUFACTURING TECHNOLOGY I (2 CREDITS)

Elementary introduction to types and organisation of engineering workshops coveringjobbing, batch, mass production. Engineering

EEE 211 ELECTRICAL ENGINEERING I (3 CREDITS)

Units.Basic circuit elements and their behaviour in DC Circuits.Basic Circuit Laws and Theorems.Introduction to A.C. Circuits.Resonance, power and power factor, -phase circuits. Transformers.Basic distribution system,introduction to DC and AC machines.

EEE 212 Electrical Engineering II (3 Credits)

Physics of devices: atomic structure, material classification, electron omission, gas discharge devices, semiconductor materials, p-n junction diode and transistor. Transistorswitching characteristics. Rectification and D.C. power supplies. Electrical measurement:voltmeters, ammeters, ohmmeters, wattmeters, energy meters, measurement of three phasepower.

EMA 281 ENGINEERING MATHEMATICS I (2 CREDITS)

1.Complex analysis: roots of a complex number. Addition formulae for any number of angles.To express sin 0 in series of sines or cosines of multiple angles.Exponentialfunction of a complex variable.Circular functions of complex variable. Hyperbolic functions. Real and imaginary parts of a circular and hyperbolic functions. Logarithmic function of a complex variable.Real numbers; sequence and series; their convergence and divergence.

4. Vector: force moment and angular velocity. Vector differentiation and integration.
5. Linear Algebra: linear spaces, algebra of determinants and matrices.
6. Calculus: differentiations and applications. The mean value theorem and its applications.Extension of mean value theorem.Taylor and Maclaurin formulae.Leibnitz's theorem. (Application to the solution of differential equations with variable coefficients), de L'Hospital's. partial derivatives of functions of two and more variables.

ENS211 ENGINEERING IN SOCIETY (2 CREDITS)

i. Philosophy of science

ii. History of engineering and technology

iii. Safety in engineering and introduction to risk analysis

iv. The role of engineers in nation building

v. Invited lecturers from professionals

CHE 211 INTRODUCTION TO CHEMICAL ENGINEERING (2 CREDITS)

Philosophy and evolution of chemical engineering, definition of chemical engineering: principles and practice, chemical engineers and the Nigerian society, chemical, processes industries in Nigeria, what some chemical engineers do for a living, introduction to chemical engineering calculations: units and dimensions.

Conversion of units: systems of units; force and weight; numerical calculation and estimation; dimensional homogeneity and dimensionless quantities; process data representation and analysis, process and process variables: mass and volume; flowrate; chemical composition; pressure; temperature.

CVE 211 STRENGTH OF MATERIALS

i. Force equilibrium:- free body diagrams, concept of stress and strain. Tensile test.

Young's moduli and other strength factors,

ii. Axial loaded bars, composite bars, temperature stresses and simple indeterminate problems.

Hoop stress: cylinders, rings.

iii. Bending moment, shear force and axial diagrams for simple cases.

ECP 281 ENGINEERING COMPUTER PROGRAMMING (2 CREDITS)

i. Computer hardware:- identification of parts and function of the components of the computer, input peripherals:- the keyboard, the mouse, the touch pad, the joy-stick and other pointing devices. The central processing unit (CPU):-the arithmetic logic unit (ALU)the primary and secondary memory (RAM, ROM etc), the frame buffer and other storage devices. The output peripherals:- the monitor, the printer, plotters and other hardcopy devices. The general operations (House-keeping):- Retrieval Manipulation and storage of data, etc

ii. Computer software: the principles and operations of the various kinds of software: system software:- windows environment, disk operating system environment (DOS), UNIX system, LINUX system, etc. Application software: word-processors, spreadsheet, databases management, work managers, presentation packages, graphics packages, draughting packages, etc.

The internet: the principle and applications of networks, WWW surfing the NET, e-mails, http and protocols.

Practical and hands-on exercises with mini-projects to test for proficiency will be emphasized.

PHY109 PRACTICAL PHYSICS (2 CREDITS)

Students are expected to carry out a minimum of 12 major experiments covering the main aspects of the courses taken in the year.

Pre-requisite: O-level or WASC.

PHY 124 ELECTROMAGNETISM AND MODERN PHYSICS (4 CREDITS)

(a) Electromagnetism- 3 Credits

Electric field: strength, flux and the inverse square law; electrostatic force between two charged particles; flux model for the electric field. Energy stored I an electric field, electrical potential due to dipole.

Steady direct currents: simple circuits; potential difference, resistance, power,

electromotive force, Kirchhoff's laws' potential divider, slide-wire potentiometer, bridge circuits, combining resistances.

Capacitors: capacitance, combination of dielectrics, energy stored charging/discharging. Electromagnetic effect: electromagnetic forces, electric motors, moving coil galvanometer, ammeter, voltmeter, electromagnetic induction dynamo.

Alternating currents: simple A.C. circuits, transformers, motors and alternating currents.

Magnetic field: the field at the center of a current-carrying flat coil, of a current carrying solenoid, outside a long solenoid, flux model and magnetic fields.

Electromagnetic induction: induction in a magnetic fields: magnitude and direction F induces an E.M.F. energy stored in a magnetic field; self-inductance.

Electricity and matter: current flow in an electrolyte, Millikan experiment; conduction of electricity through passes at low pressure, cathode rays, photo electricity.

(b) Modern Physics-1 CreditStructure of atom: atomic theory, X-ray, plack Quantum theory: wave-particle nature of matter: scattering experiment of Geiga and Marsuen, Rutherford Atom model; Bohr's atom model.

Structure of nucleus: composition of nucleus, artificial transmutation of an element. Natural transmutation of an element, discovery of neutron, particle emission, isotopes and particles emission; gamma radiation. Pre-requisite: O-level or WASC.

GST 121 USE OF ENGLISH II (2 CREDITS)

Effective communication and writing English, study skills, language skills, writing of essays, introduction to lexis, sentence construction. Outlines and paragraphs.

Collection and organisation of materials and logical presentation of papers.Use of the library, phonetics, public speaking and oral communication.