FACULTY OF ENGINEERING

Common Engineering Courses
In the first two years, all students in Engineering Faculties should, as much as possible, take the following common courses:

100 Level

Course Title	**Lecture/Lab. Units**
Mathematics	12
Physics*	10
Chemistry*	8
General Studies	8
Total	38

*Include laboratory practicals
The 100 level courses are mainly basic science subjects which are necessary for a full understanding of Engineering.

In the second year, the following courses shall be taken:
200 Level

Course Title		**Lecture/Lab. Units**
Engineering Mathematics	-	6
Computers & Computing	-	3
IT in Engineering		2
-		2
Engineering Drawing	-	3
Applied Mechanics	-	2
Strength of Materials	-	2
Thermodynamics	-	2
Material Science	-	2
Fluid Mechanics	-	3
Basic Electrical Engineering	-	2
Manufacturing Tech./Workshop Practice	-	1
Engineer – in – Society	-	6
Laboratory Practicals	-	3
Programme elective	-	8
General Studies		**46**
Total		

The 200 level courses are foundation engineering courses designed to expose students to the fundamentals of the engineering discipline in a broad sense. Students can take 3 credits as electives from their programme of study.

It is believed that exposing engineering students to the various aspects of the discipline in the first two years of their study, equips them with enough knowledge to determine their inclinations in terms of specialisation at a later stage.

This view is further strengthened by the fact that an appreciable number of engineering students have rural backgrounds which limit their erception of engineering and the sub-disciplines therein. It is believed that after the second year, the wide engineering horizon would have been sufficiently illuminated for such students, who are now better placed, to make a choice. In addition, a broad-based programme at these foundation levels becomes an asset to its beneficiaries in the future when they are invariably required to play managerial, supervisory and/or executive roles in engineering areas that may not be strictly their areas of specialisation.

100 AND 200 LEVELS COMMON COURSE DESCRIPTIONS

100 Level

Elementary Mathematics I: (3 Credit Units)
(Algebra and Trigonometry)

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers: integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem.
Complex numbers: algebra of complex numbers, the Argand Diagram, De Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

Elementary Mathematics II: (3 Credit units)
(Vectors, Geometry and Dynamics)

Geometric representation of vectors in 1 – 3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry.
Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals, Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles, resisted vertical motion. Angular momentum. Simple harmonic motion, elastic string, simple pendulum, impulse. Impact of two smooth sphere and of a sphere on a smooth surface.

Mathematics III and IV: (6 Credit units)

General Physics I: (3 Credit units)
(Mechanics)

Space and Time, frames of reference, Units and dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; Galilean invariance; Universal gravitation; work and energy; rotational dynamics and angular momentum; conservation laws.

General Physics II: (3 Credit Units)
(Electricity and Magnetism)

Electrostatics; conductors and currents; dielectrics; magnetic fields and induction; Maxwell's equations; electromagnetic oscillations and waves; Applications.

General Physics III: (2 Credit Units)

Molecular treatment of properties of matter, elasticity; Hooke's law, Young's shear and bulk moduli. Hydrostatics; Pressure, buoyancy. Archimedes' Principles. Hydro-dynamics; Stream-lines, Bernoulli and continuity equations, turbulence, Reynold's number; viscosity; laminar flow, Poiseuille's equation. Surface tension, adhesion, cohesion, capillarity, drops and bubbles. Temperature; the zeroth law of thermodynamics; heat: gas laws; laws of thermodynamics; Kinetic theory of gases. Applications.

General Chemistry I: (4 Credit Units)

Atoms, molecules and chemical reaction; Chemical equations and stoichiometry, Atomic structure and Periodicity; Modern electronic theory of atoms; Radioactivity; Chemical bonding; Properties of gases; Equilibria and Thermodynamics; Chemical Kinetics; Electrochemistry.

General Chemistry II: (4 Credit Units)

Historical survey of the development and importance of Organic Chemistry; nomenclature and classes of organic compounds; homologous series; functional groups; isolation and Purification of organic compound; Qualitative and quantitative Organic Chemistry; stereochemistry; determination of structure of organic compounds; electronic

theory in Organic Chemistry; Saturated hydrocarbons; unsaturated hydro-carbons, Periodic table and periodic properties; Valence forces; Structure of solids. The Chemistry of selected metals and non-metals and qualitative analysis.

Laboratory Practicals: (4 Credit Units)

General Physics Laboratory: (2 Credit Units)
This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc covered in General Physics I, II and III.

General Chemistry Laboratory: (2 Credit Units)
Topic in different areas of General Chemistry to be treated.

200 Level

Engineering Mathematics (6 Credits)
Complex analysis – Elements of complex algebra, trigonometric, exponential and logarithmic functions. Real number, sequences and series.
(a) Vectors – Elements, differentiation and integration.
(b) Elements of linear algebra.
(c) Calculus – Elementary differentiation. Relevant theorems.
(d) Differential equations – Exact Equations. Methods for second order equations. Partial differential equation. Simple cases – Applications.
(e) Numerical Analysis – linear equations, non-linear equations. Finite difference operators: Introduction to linear programming.

Computers & Computing (2 Credits)
Program design using pseudo-code/flowchart. Extensive examples and exercises in solving engineering problems using pseudo-code/flowchart. **Computer programming using structure BASIC such as QBASIC**: symbols, keywords, identifiers, datatypes, operators, statements, flow of control, arrays, and functions. Extensive examples and exercises in solving engineering problems using QBASIC. **Use of Visual programming such as Visual BASIC** in solving engineering problems. **15hrs (Teaching & Demonstrations), 30hrs (Practicals)**

IT in Engineering (2 Credits)
Identification of PC parts and peripheral devices: functions, applications, and how to use them. Safety precautions and preventive maintenance of PC. **Filing system**: directory, sub-directory, file, path, and how to locate them. **Word processing**: principle of operation, applications, demonstrations, and practical hand-on exercises in word processing using a popular word processing package. **Internet**: available services, principle of operation, applications, demonstrations, and hand-on exercises in e-mail, and www. **Spreadsheet**: principle of operation, applications, demonstration, and practical hands-on exercises in use of spreadsheets to solve problems. **Database Management package**: principle of operation, applications, demonstrations and practical hands-on exercises in use of DBMS package in solving problems. **Report Presentation Software Packages**: principle of operation, applications, demonstrations, and practical hands-on exercises in use of a popular report presentation package (such as PowerPoint). **Mini-project** to test proficiency in use of software packages. **15hrs (Teaching & Demonstrations), 30hrs (Practicals)**

Engineering Drawing **(2 Credits)**

(i) Use of draughting instruments, lettering, dimensioning, layout.
(i) Engineering graphics - Geometrical figures, comics, etc. Graphical calculus and Applications. Development, intersection of curves and solids.
(ii) Projections - lines, planes and simple solids. Orthographic and projections, simple examples Threaded fastness.
(iii) Pictoral/Freehand Sketching.
(iv) Conventional practices.
(v) Introduction to Computer Aided Drafting: Electronic draughting packages: principle and use in engineering design. Simulation packages: principle and use in engineering.

Applied Mechanics **3 Credits**

Statics Laws of statics, system of forces and their properties, Simple problems, Friction.

(i) Particle dynamics - Kinematics of plane motion. Newton's laws - Kinetics of particles, momentum and energy methods.
(ii) Kinematics of rigid body - velocity and acceleration diagrams for simple problems.
(iii) Kinetics of rigid bodies - Two dimensional motion of rigid bodies, energy and momentum, Mass, Moment of inertia, Simple problems.
(iv) Simple harmonic motions.

Strength of Materials **2 Credits**

(i) Force equilibrium - free body diagrams.
(ii) Concept of stress, strain; Tensile test. Young's moduli and other strength factors.
(iii) Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems. Hoop stresses in cylinders and rings.
(iv) Bending moment, shear force and axial force diagrams for simple cases, Simple torsion and application.

Thermodynamics **2 Credits**

(i) Basic concepts, definitions and laws.
(ii) The ideal gas, Heat and Work.
(iii) The first Law of thermodynamics, applications to open and closed systems.
(iv) The steady State flow equation (Bernoulli's Equation) and applications.
(v) Second law of thermodynamics and Heat Cycles.

Materials Science **2 Credits**

Atomic and molecular structure, crystals, Metallic states, Defects in crystals, conductors, semi-conductors and insulators.

(i) Alloy theory - Application to industrial alloys - steel in particular.
(ii) Engineering Properties - Their control, Hot and cold working, heat treatment, etc. Creep, fatigue and fracture. Corrosion and corrosion control.
(iii) Non-metallic materials - glass, rubber, concrete, plastics, wood and ceramics.
(iv) Elastic and plastic deformations: Defects in metals.

Fluid Mechanics **2 Credits**

(i) Elements of fluid statics; density; pressure, surface tension, viscosity, compressibility etc.
(ii) Hydrostatic forces on submerged surfaces due to incompressible fluid.
(iii) Introduction to fluid dynamics - conservation laws.
(iv) Introduction to viscous flow.

Chemistry **2 Credits**

Thermo-chemistry, electro-chemistry, kinetic theory, gas laws, transition metals, introductory organic and inorganic chemistry.

Basic Electrical Engineering **3 Credits**

(i) Circuits – elements, DC and AC circuits, Basic circuit laws and theorems. Resonance, power, power factors, 3-phase circuits.
(ii) Introduction to machines and machine designs.
(iii) Physics of devices – Discharge devices, semi-conductors, diode and transistors.
(iv) Transistor characteristics, devices and circuits
(v) Electrical and electrical power measurements.

Manufacturing Technology/Workshop Practice 2 Credits

Elementary introduction to types and organisation of engineering Workshop, covering jobbing, batch, mass production.

(i) Engineering materials: their uses and properties.
(ii) Safety in workshop and general principles of working. Bench work and fitting: Hand tools, instruments.
(iii) Carpentry: Hand tools and working principles. Joints and fastenings: bolt, rivet, welding, brazing, soldering. Measurement and marking: for uniformity, circulatory, concentricity, etc.
(iv) Blacksmith: Hand tools and working principles. Joints and fastenings: Bolt, rivet, welding, brazing, soldering, measurement and marking: for uniformity, circulatory, concentricity, etc.
(v) Standard measuring tools used in workshop: Welding, brazing and soldering: Principles, classification, power source.
(vi) General principles of working of standard metal cutting machine tools.
(viii) Invited lectures from Professionals

Engineer-In-Society **1Credit** Philosophy of Science

(i) History of Engineering and Technology
(ii) Safety in Engineering and Introduction to Risk Analysis
(iii) The Role of Engineers in Nation Building
(iv) Invited Lectures from Professionals.

Laboratory Practicals **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

B. ENG. CIVIL ENGINEERING

	Course Title	Lecture/Lab. Units
(a)	**Course Summary**	
	(i) **Core Courses**	
	Engineering Mathematics/Analysis	15
	Engineering/Construction Drawing	7
	(ii) **Structural Engineering**	
	Structural Analysis (7) }	
	Design of Structures (7) }	
	Civil Eng. Materials (3) }	22
	Strength of Materials (3) }	
	(iii) **Geotechnical Engineering**	
	Soil Mechanics (5) }	16
	Foundation Engineering (4) }	
	Geology (3) }	
	Highways Engineering (2)	
	Transportation Engineering (2)	
	(iv) **Water Resources & Environmental Eng.**	
	Fluid Mechanics }	13
	Hydraulics }	
	Hydrology }	
	Public Health }	
	Geodetic Eng. & Photogrammetry	6
	Civil Engineering Practice	2
	Engineer-in-Society	1
	Project	6
	(v) **Laboratory/Design Practicals**	21
	(vi) **Auxiliary Courses**	
	Thermodynamics	2
	Applied Mechanics	3
	Materials Science	2
	Manufacturing Technology	2
	Electrical Engineering	4
	Management and Economics	6
	Computers & Computing	3
	Technical Communications	2
	(vii) **Basic Science Courses**	
	Mathematics	12
	Physics	10
	Chemistry	8
	(viii) **General Studies**	
	General Studies	16
	(ix) **Entrepreneurial Studies**	4
	(x) **Optional/Electives**	6

Compulsory Options/Electives from:	
Advanced Structural Analysis	
Geotechnical Engineering	
Water Resources & Environmental Eng.	
Highways & Transportation Engineering	
Building/Construction Engineering	
Total	**193**

(b) **Break-Down of Courses Into Levels of Study**

300 Level	
Engineering Mathematics	6
Fluid Mechanics	3
Strength of Materials	3
Engineering Geology	3
Elements of Architecture	3
Civil Engineering Materials	3
Soil Mechanics	3
Design of Structures	3
Structural Mechanics	3
Engineering Surveying & Photogrammetry	3
Foundation Course in Entrepreneurial Studies	2
Hydrology	2
Hydraulics	2
Laboratory Practicals/Design Studies	6
Sub-Total	**45**
400 LEVEL	
Engineering Mathematics	3
Civil Engineering Practice	2
Structural Analysis I	2
Design of Structures II	2
Soil Mechanics	2
Engineering Surveying & Photogrammetry	3
Highway Engineering	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals/Design Studio	3
Sub-Total	**23**
500 Level	
Management and Economics	6
Structural Analysis II	2
Design Structures III	2
Geotechnical Engineering	3
Water Resources & Environmental Engineering	4
Highway Engineering	2
Transportation Engineering	2
Laboratory/Design	6
Safety Engineering	2
Project	6
One Optional Course (See below)	6

Optional Courses

Advanced Structural Analysis	
Highway & Transportation Engineering	
Water Resources & Environmental Engineering	
Construction Engineering	2
Geotechnical Engineering	**40**
Drainage and Irrigation Engineering	
Total	

COURSE DESCRIPTIONS

300 Level

(i) **Mathematics** **6 Credits**

Linear Algebra – Elements of matrices, determinants, Inverse of matrix. Theory of linear equations, eigen-values and eigen-vectors.Analytic geometry – co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates. Elements of functions of several variables.Numerical differentiation, solution of ordinary differential equations. Curve fitting. Simple linear programming. Fourier series – Euler coefficients, even and odd functions, Sine and Cosine, functions, simple applications, Gamma, Beta and probability functions. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, Surface and volume integrals and related theorems.

(ii) **Fluid Mechanics** **3 Credits**

Fluid statics: Floatation and stability.
Dynamics of fluid flow-conservation equation of mass and momentum: Euler and Bernoulli equations. Introduction to incompressible viscous flow. Reynold's Number. Dimensional analysis – Philosophy, Similitude, Buckingham PI theorems. Applications. Hydraulic model. Flow measurements. Flow meters, errors in measurement.

(iii) **Strength of Materials** **3 Credits**

Advanced topics in Bending moment and shear force in beams.Theory of bending of beams. Deflection of beams. Unsymmetrical bending andshear center. Applications. Strain energy. Biaxial and triaxial state of stress.Transformation of stresses. Mohrs circle. Failure theories. Springs.Creep, fatigue,Fracture and stress concentration.

(iv) **Engineering Geology** **3 Credits**

Geological structures and mapping. Rocks and minerals. Stratigraphy – time scale– fossils and their importance: special reference to Nigeria. Introduction to geology of Nigeria. Engineering Applications – Water supply, site investigation – Dams, Dykes, etc.

(v) **Elements of Architecture** **2 Credits**

Introduction – Dimensional awareness, Graphic communication, relation to environments. Free hand drawing – form in terms of shades, light and shadow. Orthographics; dimetrics, perspective projections: Applications. Common curves. Elementary Designs. Computer Aided Design and Drawing (CADD)

(vi) **Civil Engineering Materials** **3 Credits**

Concrete Technology – Types of cements, aggregates – properties, Concrete mix. Design, Properties and their determination. Steel Technology – Production, fabrication and properties: corrosion and its prevention. tests on steel and quality control. Timber Technology – Types of wood, propertie, defects. Stress grading, Preservation and fire protection. Timber products. Rubber, plastics; Asphalt, tar, glass, lime, bricks, etc. Applications to buildings, Roads and Bridges.

(vii) **Soil Mechanics** **3 Credits**

Formation of soils. Soil in water relationship – void ratio, porosity, specific gravity and other factors. Soil classification: Atterberg limits – particle size distribution. Flow in soils – seepage and permeability. Laboratory work.

(viii) **Design of Structures I** **3 Credits**

Fundamentals of design process, materials selection, building regulations and codes of practice. Design philosophy, Elastic design: Limit State design. Design of structural elements in Reinforced concrete. Further work in Computer Aided Design

(ix) **Structural Mechanics** **3 Credits**

Analysis of determinate structures, Beams, Trusses; Structure Theorems.
Graphical methods: Aplication to simple determinate trusses. Williot Mohr diagram. Deflection of statistically determinate structures. Unit load, moment area methods. Strain Energy Methods. Introduction to statistically indeterminate structures.

(x) **Engineering Surveying & Photogrammetry 3 Credits**

Chain Surveying. Compass surveying – Methods; Contours and their uses. Traversing – methods and applications. Levelling – Geodetic leveling – errors and their adjustment Applications. Tacheometry – Methods; Substance heighting, self adjusting and electromagnetic methods. Introduction to Photogrammetry.

(xi) **Hydraulics** **2 Credits**

Simulation of complex flow fields using sources, sinks uniform flows and doublets and combinations of vortices. Steady and unsteady flows in open channels. Dimension analysis and similitude. Hydraulic modeling techniques, Pipe network analysis, Design of reticulation systems. Unsteady flows in pipes with special emphasis on water hammer and the use of surge tanks.

(xii) **Hydrology** **2 Credits**

The hydrologic cycle. Precipitation, infiltration, evaporation, groundwater, surface run-off, floods and droughts. Physical and statistical analysis related to hydrologic processes. Flood routing techniques. Hydrologic systems analysis. Hydrography analysis. Unit hydrograph theory. Occurrence and distribution of water in nature. Hydrogeology, Fundamentals of flows in porous media. Equations governing flows in aquifer. Exact and approximate solutions. Flows in layered aquifer systems.

(xiii) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes in alternate weeks.

400 LEVEL

(i) **Engineering Mathematics** **3 Credits**

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – Applications.
Introduction to non-linear differential equations – stability and Applications. Probability – elements of probability, density and distribution functions, moments, standard distribution, etc. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(ii) **Drainage and Irrigation Engineering 2 Credits**

Analysis and design of surface and combined drainage systems, collectors, storages and pumps. Methods of overflow protection of large areas. Analysis and design of irrigation systems. Soil-plan-water relationships. Water supplies, water delivery systems and water distribution systems.

(iii) **Civil Engineering Practice** **2 Credits**

Civil Engineering Work Standards and measurements. Contracts and sub-contracts. Works construction and supervision. Job planning and control – Programme Charts – Bar charts. Critical path methods, etc. Construction machinery and equipment. Applications/Case study-dams, foundations, bridges, highways, industrial buildings, sewage works.

(iv) **Structural Analysis I** **3 Credits**
Indeterminate structural analysis: Energy and Virtual work Methods, Slope deflection and Moment distribution methods.Elastic Instability. Simple plastic theory of bending. Collapse loads. Stress-Grading of Timber, visual mechanical and electronic stress grading of Timber.

(v) **Design of Structures II** **2 Credits**
Limit state philosophy and Design in steel: Elastic and Plastic moment Designs. Design of Structural Elements in steel and connections and Joints. Limit state philosophy and design in Timber. Elastic methods and Design in Timber. Design of structural elements in Timber and Timber connectors. Laboratory Tests on Structural elements in Concrete, Timber and Steel. Computer Aided Design of structures

(vi) **Soil Mechanics** **2 Credits**
Mineralogy of Soils. Soil Structures. Compaction and Soil stabilisation. Site Investigations. Laboratory and Coursework.

(vii) **Engineering Surveying & Photogrammetry 3 Credits**
Further work on contours and contouring: Methods of contouring, contour interpolation and uses of contour plans and maps. Areas and Volumes. Setting out of Engineering Works. Elementary topographical surveying: Elements of photogrammetry, Photogrammetry equipment and Errors of Measurement.

(viii) **Highway Engineering** **2 Credits**
Soil Engineering Aspects of Highways. Railways and Airfields.Highway Geometrics. Pavement Structure and Design. Pavement materials and Laboratory Tests.

(ix) **Technical Communications** **2 Credits**
Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing. Project report presentation. 15 hrs (Teaching & demonstrations), 30hrs (Practicals).

(x) **Laboratory/Design Practicals** **3 Credits**
All courses share the Laboratory schedules to suit; sometimes in alternate weeks.

500 Level

(i) **Management and Economics** **4 Credits**
The Management of Environment: Formation of a company, sources of finance, money and credit. Insurance. National policies. GNP growth rate and prediction. Organisational Management: Principles and elements of organisation. Organisation charts. Functions. Types. Principles of Management. Schools of thought. Office and production management. Management by Objectives. Financial Management: Accounting methods. Financial statement. Elements of costing. Cost planning and control. Budget and Budgeting control. Cost reduction programmes. Depreciation accounting, valuation of assets. Personnel Management: Selection, recruitment and training. Job evaluation. Merit rating. Incentive schemes. Industrial Committees and joint Consultations. Trade Unions and collective bargaining. Industrial Psychology: Individual and Group Behaviour. The learning process. Motivation and Morale. Influence of the Industrial Environment. Resources Management. Materials Management: Purchasing methods. Contracts. Interest formula. Rate of return. Methods of economic evaluation. Selection between alternatives. Tendering evaluation and contract administration. Planning and Decision Making: Forecasting Planning, Scheduling. Production control Gantt Chart. C.P.M. and PERT. Optimisation. Linear

programming as an aid to decision making policies under risk and uncertainties. Transport and Materials Handling: Selection of transport media for finished goods, raw materials and equipment. Faculty layout and location.
Work Study and Production Processes: Basic principles of work study. Principles of motion economy. Ergonomics in the design of equipment and process.

(ii) **Structural Analysis II** **2 Credits**
Plastic Methods of Structural analysis. Matrix Methods of Structural analysis. Elastic Instability. Continuum of plane strain, elastic flat plates and torsion, solution by series, finite difference, finite element. Yield line Analysis and Strip methods for slabs.

(iii) **Design of Structures III** **2 Credits**
Composite Design and construction in Steel and Reinforced Concrete. Design of Structural Foundations. Pre-stressed concrete Design. Modern Structural form. Tall Buildings, Lift shafts and shear walls, system buildings. Design projects.

(iv) **Geotechnical Engineering 4 Credits**
Stresses in Soils. Consolidation and settlement. Shear Strength of Soils. Earth Pressures. Bearing Capacity of Soils. Foundations: Normal and Deep Foundations. Slope Stability. Site Investigations.

(v) **Water Resources and Environmental Engineering 4 Credits**
The Hydraulics of open channels and Wells .Drainage. Hydrograph Analysis. Reservoir and Flood-routing. Hydrological forecasting Hydraulic Structures, i.e. Dams, Dykes/Levees, Weirs, Docks and Harbours, Spillways, Stilling basins, Man Holes and Coastal Hydraulic Structures, etc. Engineering Economy in Water Resources Planning

Environmental Engineering **2 Credits**
The work of the Sanitary Engineer. Water Supply, Treatment and Design. Waste Water Collection, Treatment, Disposal and Design. Solid waste Collection, treatment, disposal and design of systems. Air Pollution and Control.

(vi) **Highway Engineering** **2 Credits**
Highway Planning and Traffic Surveys. Pavement Design. Construction and maintenance. Administration and Finance of Highways.

(vii) **Transportation Engineering** **2 Credits**
Coordination of all Transportation Media. Transportation Planning and Economics. Traffic Management and Design of Traffic Signals. Parking. Geometric Design. Construction Methods. Construction. Materials and Laboratory Tests.

(viii) **Laboratory/Design** **6 Credits**
Courses (ii) – (vii) should carry Laboratory/Design works while (i) carry case Study/Feasibility Report assignments.

(ix) **Project** **6 Credits**
For proper guidance of the students, Projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their. Optional course. (See below)

(x) **Optional Course** **6 Credits**
The Option Course is to be taken from the following: Advanced Structural Engineering. Highway and Transportation Engineering. Water Resources and Environmental Engineering. Building/Construction Technology. Geotechnical Engineering. The Options should aim at standards normally higher than the Bachelor's degree but below Master's degree expectations and calling for an in-depth study in the above areas.

B. ENG. COMPUTER ENGINEERING

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
	(ii)	**Basic Sciences**	
		Mathematics	12
		Physics	10
		Chemistry	8
		Total	**46**
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Basic Engineering Courses**	
		Engineering Mathematics	6
		Computers & Computing	3
		Engineering Drawing	4
		Applied Mechanics	4
		Strength of Materials	2
		Material Science	3
		Thermodynamics	2
		Fluid Mechanics	2
		Basic Electrical Engineering	6
		Manufacturing Techniques/Workshop Practice	2
		Engineer-in-Society	1
		Total	**36**
	(v)	**Core Courses**	
		Engineering Mathematics	12
		Embedded system design	3
		Analogue Electronic Circuits	3
		Digital Electronic Circuits	3
		Measurements and Instrumentation	3
		Circuit Theory	6
		Digital System design with VHDL	3
		Control System	3
		Communication Principles	3
		Electrical Machines	3
		Software Engineering	3
		Computer Programming	2
		Assembly Language Programming	3
		Software Development Techniques	3
		Microprocessor system & Interfacing	3
		Laboratory Practicals	9
		Artificial Neural Network	3
		Computer Graphics & Animations	3
		Computer Organisation & Architecture	3
		Cyberpreneuship & Cyberlaw	2
		Computer Security Techniques	3
		Data Communication & Network	3
		Prototyping Techniques	2
		Digital Signal Processing	3
		Reliability & Maintainability	3
		Project	6
		Electives	4
		Total	**98**

Course Title

(b) **Break-Down Of Courses Into Levels Of Study:**

Core Courses 300 Level	6
Engineering Mathematics	3
Electromagnetic Fields & waves	3
Computer Organisation & Architecture	4
Entrepreneurial Studies	3
Circuit Theory	3
Analogue Electronic Circuit	3
Digital Electronic Circuit	3
Communication Principles	3
Measurement & Instrumentation	3
Electrical Machines	3
Laboratory Courses	3
Software Development Techniques	**40**
Total	

CORE COURSES 400 LEVEL	2
Technical Communications	3
Microprocessor System & Interfacing	3
Control System	3
Data Communication & Network	3
Assembly Language Programming	3
Object Oriented Design & Programming	2
Laboratory Course	2
Prototyping Techniques	6
SIWES (Industrial Training)	**27**

CORE COURSES 500 LEVEL	3
Reliability and Maintainability	3
Embedded system design	3
Software Engineering	3
Digital Signal Processing	3
Digital System design with VHDL	3
Artificial Neural Network	2
Cyberpreneurship & Cyberlaw	3
	3
Computer Graphics & Animation	6
Computer Security Techniques	
	2
Project	2
Electives (2):	2
Robotic & automation	2
Digital Image Processing	2
Digital Speech Processing	**34**
Fuzzy logic & Programming	
Cryptography Principles & Applications	
Total	

COURSE DECRIPTIONS

300 Level

Computer Organisation and Architecture **3 Units**

Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored program concept. Von-Neuman architecture. Havard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types), Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor. Control Unit: Micro-operations, control of the CPU, hardwired implementation, control unit operation, micro-instruction sequencing and execution, micro-programmed control. Use INTEL family, and MOTOROLA family as case study of a CISC computer system. Instruction Set and Register: Machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organization, instruction pipelining. High performance computer systems: Techniques to achieve high performance, pipelining, storage hierarchy, units with function dedicated for I/O. RISC, introduction to superscalar processor, parallel processor. Use popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating System: Overview of operating system, dimension and type of operating system, high level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory, UNIX/LINUX operating system: architecture, commands, programming; window based operating systems (MS windows, X-window).

Software Development Techniques **3 Units**

Software development life cycle. Top-Down design. Program, design using pseudo-code, flowchart. Flowchart ANSI symbols and usage. Extensive examples, and exercises using pseudo-code/flowchart to solve practical problems in engineering. Debugging and documentation techniques. Programming using a structural language such as C: Symbols, keywords, identifiers, data types, operators, various statements, operator precedence, type conversion, conditional and control structures, function, recursive functions. Arrays: 1-D, and multi-dimensional arrays, passing elements or whole array to a function. Simple sorting and searching on arrays, pointers, strings, dynamic memory allocation. Structures and Unions: Structure declaration and definition, accessing structures, array of structures, pointers and structures, union declaration, enumerated variables. File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files. Advanced Topics: Command line parameters, pointers to functions, creation of header files, stacks, linked lists, bitwise manipulation. Software development in C in MS Windows, UNIX/LINUX environments, header file, preprocessor directives, make, makefile. Static and dynamic linking libraries. Extensive examples, and exercises programming in C to solve practical problems in engineering. Exercises are to be done in the Computer Laboratory.

Analogue Electronic Circuit (3)

See Electrical and Electronics Engineering.

Digital Electronic Circuit (3)

See Electrical and Electronics Engineering.

Communication Principles 3
See Electrical and Electronics Engineering.

Electrical Machine 3
See Electrical and Electronics Engineering.

Electromagnetic Field & Waves
See Electrical and Electronics Engineering.

400 Level

Control System 3 Units
Introduction: definition, examples of control systems. Open-loop and closed-loop control systems. Review of Laplace and inverse Laplace transforms. System modelling: Signal flow graph, block diagram. Transfer function. Poles and zeros. Block diagram reduction using signal flow graph and block diagram reduction techniques. Mechanical, electrical and electromechanical systems. First and second order models, higher order models. Definitions of transient response parameters. Analysis of second-order system as prototype. Routh-Hurwitz stability criterion. Classification of systems based on steady-state characteristics, steady-state error coefficient. Definition of Root locus, Properties of root locus, sketching of root locus plots. Effect of open-loop zeros and poles. Root locus design concepts. Frequency response analysis and design: Bode diagram, Polar plot, Nichols plot. Nyquist stability criterion: non-mathematical description of Nyquist criterion, interpretation of stability. Relative stability - Gain and phase margins. Closed-loop frequency response analysis - M and N contours, Nichols chart. Compensation techniques: lag, lead and lag-lead compensation, PD, PI and PID controllers. Cascade compensation based on root-locus method. Introduction to Feedback compensation. Computer-aided design and analysis of control system.

Data Communication and Network 3 Units
Introduction to Data communications: the Development of Data Communications; types and sources of data, simple communications network, transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronization, character synchronization, character synchronization, synchronous transmission, asynchronous transmission, efficiency of transmission, error detection methods and data compression. Protocols: Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding and dynamic Huffman coding. Local Area Networks: medium access control techniques – Ethernet, token bus and token ring; LAN standards; fibre distributed data interface, metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface independence, platform independence, transaction processing, connectivity, reliability, backup and recovery mechanisms. Information Network Software; Features and benefits of major recovery mechanisms. Information Network Software: features and benefits of major Network Operating Systems. Network OS: (e.g. Novell NetWare, UNIX/LINUX, OS/2 & WindowsNT). TCP/IP and Network OS. INTERNET: Definition, architecture, services, Internet addressing. Internet protocol, IPv4, IPv6. Internet programming, Intranet. System administration, and security issues.

Prototyping Techniques 2 Units
Introduction: Grounding, ground plane, digital ground, analogue ground, power decoupling, inductance and capacitive effects, feedthrough capacitors. Soldering techniques for pass-through and surface mount components, desoldering.

Breadboarding, veroboarding. Wire wrapping techniques. Radio Frequency design and implementation techniques. Printed Circuit Board techniques, and production of PCB. Use of PCB CAD packages. Construction exercises using different prototyping techniques.

Microprocessor System and Interfacing 3Units

A basic microprocessor system: the CPU, memory, I/O, and buses subsystems, basic operation of a microprocessor system: fetch and execute cycle, the architecture of some typical 8-bit, 16-bit microprocessors (INTEL, MOTOROLA) and their features. Programming model in real mode: registers, memory, addressing modes. Organisation of the interrupt system, interrupt vectors, and external interrupts, implementation of single and multiple interrupts in real mode. Programming model in protected mode: registers, memory management and address translation, descriptor and page tables, system control instructions, multitasking and memory protection, addressing modes, and interrupt system. Memory interfacing and address decoding. I/O interfacing: memory mapped i/o, isolated i/o, bus timing, i/o instructions. Peripheral devices interfacing: 8255 PPI/6821 PIA, 8251 USART/6821 UART, DMA, Timer/Counter chips, etc. Instruction set. Assembly language Programming of INTEL and MOTOROLA microprocessors. Discussion of a typical system e.g. IBM PC, Apple Macintosh.

Assembly Language Programming 3 Units

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

500 Level

Cyberpreneurship & Media Law 2 Units

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

Digital System Design with VHDL **3 Units**

Finite State Machine: definition, mealy and moore models, state diagram, state table, transition table. Sequential circuits design using flip-flops, asynchronous, and synchronous circuit design. Algorithm State Machine. Design examples and exercises. Structured Design: Design constructs, Design Levels, Geometry-based interchange formats, Computer aided electronic system design tools, Schematic circuit capture, Hardware description languages, Design process (simulation, synthesis), Structural design decomposition. Introduction to VHDL: VHDL language abstractions, Design hierarchies, VHDL component, Lexical description, VHDL source file, Data types, Data objects, Language statements, Concurrent VHDL, Sequential VHDL, Advanced features of VHDL (library, package and subprograms). Structural level modeling, Register-Transfer level modeling, FSM with datapath level modeling, Algorithmic level modeling. Introduction of ASIC, Types of ASIC, ASIC design process, Standard cell ASIC synthesis, FPGA Design Paradigm, FPGA synthesis, FPGA/CPLD Architectures. VHDL Design: Top-down design flow, Verification, simulation alternatives, simulation speed, Formal verification, Recommendations for verification, Writing RTL VHDL code for synthesis, top-down design with FPGA. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer-aided design of logic circuits.

Digital Signal Processing **3 Units**

Introduction: Advantages of digital over analogue signal processing, problems of digitization, overview of application of DSP, basic elements of DSP system. Digital Processing of analogue signals: Sampling of analogue signals, sampling theorem, aliasing, quantization, noise, and coding, types and selection of ADC/DAC, Sigma-delta ADC. Analytical tools: z-transform, properties, transfer function, inverse z-transform, z-plane poles and zeros, analysis of linear time-invariant in z-domain, system stability. Discrete Fourier Analysis: Discrete Fourier Transform and properties, inverse DFT, truncated fourier transform, windowing, FFT algorithms. Discrete Time Signals & systems: Discrete time sequences (signals), classification and determination of discrete time system, discrete time i/o description (difference equation), solution of difference equations, convolution, correlation, impulse response. Digital Filters: Definition and types. FIR filters: Transfer function, characteristics, applications, design methods, Gibb's effect and elimination, fir filter realisation. IIR filter: Transfer function, characteristics, applications, overview of analogue filter design techniques, design methods-conversion from analogue to digital filter design techniques, IIR filter realization. Structure of Discrete Time System: Block diagram representation of constant coefficient difference equations, IIR and FIR systems and their basic structures, stability of discrete time systems. Software implementation of dsp algorithms. DSP Microprocessors: Architecture, fixed point vs floating point DSP, Finite word length effects. DSP chips: interfacing and programming. Practical application of DSP in audio, and video.

Reliability and Maintainability **3 Units**

Introduction to reliability, maintainability, reliability specification and metrics. Application to computer hardware system, communication equipment, power systems, electronic components. Basic maintenance types, and procedures of computer and digital communication system. Fault troubleshooting techniques. QoS and time of availability of data communication. Quality control techniques. Design for higher reliability, fault tolerance. Software Reliability: software reliability specification, software reliability Metrics, fault avoidance, fault tolerance, programming for reliability, software safety and hazard analysis. Comparison of hardware and software realiability. Software Quality and Assurance: definition of software quality, software quality factors, quality control, cost of quality, quality assurance. SQA activities, formal technical reviews, software quality metrics, statistical quality assurance. ISO 9000 Requirements and Certification, ISO 9000-3 for software quality process, process documentation, quality audit. Capability Maturity Model: Software Engineering Institute, levels of maturity, key process areas, Comparison between ISO 9000 Standards and CMM. Ensuring Quality and Reliability:

verification and validation, measurement tracking and feedback mechanism, total quality management, risk management.

Embedded System Design **3 Units**

Introduction to embedded system, components, characteristics, applications. Intel 8051/8031 Micro-controller: Features of the 8051/8031 family, block diagram and definitions of the pin of the 8051, I/O port structure, memory organisation: general purpose RAM, bit addressable RAM, register bank, special function registers, external memory, memory space mapping and decoding, bus control signals timing, a typical 8051 micro-controller based system. Instruction Set and Assembly Language Programming: Addressing modes, the 8051 instruction set and typical examples, assembler operation, assembly language format, assembler directives, operation of assemblers and linkers, programming examples. On-chip Peripheral Devices: I/O ports, operations and uses of port 0, port 1, port 2, port 3, timers: their operations, programming, and applications, serial port: operations and programming, typical applications, serial port interrupt. Interfacing to external memory, keypad, seven-segment LED display, ADC and DAC chips, and input / output port expansion, description and uses of hardware development tools. MOTOROLA M6811 Micro-controller: Features of the M6811 family, block diagram and definitions of the pin of the M6811, I/O port structure, memory organisation: general purpose RAM, bit addressable RAM, register bank, special function registers, external memory, memory space mapping and decoding, bus control signals timing. Instruction Set and Assembly Language Programming. On-chip peripheral devices and I/O interfacing. Introduction to PIC microcontroller: general architecture, applications and selection of microcontroller, advantages, low-end, and high performance PIC. Specific PIC microcontrollers: Features, architecture, block diagram, pin configuration, on-chip memory, and peripheral. Instruction set and Assembly language programming. Serial I/O interfacing: I2C, and SPI interfacing and programming. Memory interfacing: external memory interfacing, EEPROM and Flash memory interfacing. Design exercises using development system.

Neural Network & Programming **2 Units**

Neural Network: Definition of artificial neural network. Similarities of neural network with human brain. Classification of ANN. Terminologies: input/output sets, weights, bias or threshold, supervised learning, network training, Convergence process, single layer vs. multilayer perception, Forward and Backward propagation, gradient descent rule. Back-propagation neural network, Variable term used in back propagation neural network: learning rate, momentum, hidden nodes, sigmoid activation function. Back propagation algorithm of ANN. Design of ANN model, training sets for ANN, test sets for ANN, network testing and performance. Engineering applications. ANN programming.

Computer Security Techniques **2 Units**

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

Interconnection Issues, Firewalls [Gateways, Application, Cost and Effectiveness .Database Security: Security Requirements to Databases, Designing the Security, Methods of Protection, Security of Multilevel Database .

Digital Image Processing **2 Units**

Introduction: definition, problems, and applications of digital image processing. Digital image acquisition devices. Digital image formats. Edge detection techniques, segmentation methods. Image Morphology. Image enhancement. Image restoration techniques. Morphology. Fourier transform and Wavelet transform in image processing. Image registration techniques. Shape analysis. Image understanding. Artificial neural network and image understanding. Colour representation standards, equations, processing, quantization, and dithering. Case study: practical application of image processing to face recognition, fingerprint, iris, etc. Introduction to image compression techniques.

Fuzzy Logic & Programming **2 Units**

Introduction: fuzzy set theory, knowledge base problem, objective and subjective knowledge, crisp sets, fuzzy sets, linguistic variables, membership functions. Set theoretic operations, comparison between crisp sets and fuzzy sets. Law of Contradiction and Law of Excluded Middle, fuzzy intersection, union and complement, and other fuzzy operators. Fuzzy relations and compositions on the same and different product spaces. Max-Min composition, Max-Product composition, fuzzy relational matrix, sup-star composition. Hedges or modifiers of linguistic variables, fuzzy logic vs. probability. Fuzzy reasoning and implication, the fuzzy truth tables, traditional propositional logic and the rule of inference, the Modus Ponens and Modus Tollens, fuzzy modeling with causal IF-THEN statements. Fuzzy Models, fuzzy logic systems, combination of fuzzy basis functions, universal approximator, fuzzy neural network, fuzzy associate memory matrix, self-learning fuzzy systems. Fuzzy logic system applications. Fuzzy programming.

Robotic & Automation **2 Units**

Robot classification and manipulation. Technology and history of development of robots. Applications. Direct and inverse kinematics: arm equation. Workspace analysis and trajectory planning. Differential motion and statics. Manipulator dynamics. End-of arm tooling. Automation sensors. Robot vision. Work-cell support systems. Robot and system integration. Safety. Human interface. Robot control system. Circuit and system configuration. Task oriented control. Robot control programming. Fuzzy logic and AI based robot control. Fundamentals of automation. Strategies and economic consideration. Integration of systems. Impact to the production factory. Evaluation of conventional processes. Analysis of automated flow lines. Assembly systems and line balancing. Automated assembly systems. Numerical control and adaptive control. Robot applications. Automated materials handling and storage systems. Automation in inspection and testing. Linear feedback control system. Optimal control. Computer process control. Computer integrated manufacturing systems. Future automated factory.

Cryptography Principles & Applications **2 Units**

History of cryptographic System, Public Key Systems, Digital Signatures. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Methods : Transposition Ciphers, Substitution Ciphers, Product Ciphers, Exponentiation Ciphers, Knapsack Ciphers, Breakable NP-Complete Knapsack, Encryption Standards DES, RSA, Elliptic Curves. Cryptographic Techniques: Block and Stream Ciphers, Autokey, Endpoints of Encryption, One-way Ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold Scheme. Video scrambling techniques. Digital video encryption techniques: principle, IRDETO, Viaaccess, Videoguard, etc. Security and Legality Issues: Copyrights, Patents, Trade Secret, Ownership of Products, Computer Crimes, Ethical Issue in Computer Security.

Design & Installation of Electrical & ICT services 3 Units

Electrical Installation: Induction to Health and safety at work act in Nigeria. Electrical safety. First aid. Electricity supply regulations. Lighting and Illumination: Luminous intensity and flux. Maintenance factor. Coefficient of utilization. Types of light sources. Calculation of lighting requirements. Glare. Stroboscopic effect. Installation Materials, cables, junction box, terminations, joints. Conduits and conduiting. Truck and trucking. Electrical Installation design in domestic, commercial and industry. Alarm and emergency systems. Earthling and Protection. Purposes of earthing. Faraday cage. Rod electrodes. Earth electrode resistance. Earthing system. Earth fault loop impedance. ICT services: NCC and FCC codes of practice and standards. Telecommunication design and installation: Satellite, VSAT, etc. Telephone design and installation. Computer networking design and installation. Wireless LAN design and installation. Preparation of Bill of Engineering Measurement Evaluation. Contract bidding. Consultancy.

Computer Security Techniques 2 Units

History of cryptographic System, Public Key Systems, Digital Signature. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Method Ciphers, Knaspsack Ciphers, Breakable NP-Complete Knapsack, Encryption Standards DES, RSA, Elliptic Curves. Cryptographic Techniques: Block and Stream Ciphers, Autokey, Endpoints of Encryption, One-Way Ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold Scheme. Video Scrambling techniques. Digital video encryption techniques: principle, IRDETO, Viaaccess, Videoguard, etc. Security and Legality Issues: Copyrights, Patents, Trade Secret, Ownership of Products, Computer Crimes, Ethnical Issue in Computer Security.

Computer Graphics & Animations (3Units)

Overview of 3D animation and its application and types. Coordinate system, vertex, faces and object. Concept of wireframe, surface and solid modeling. Construction planes and differences between object space and world space. Principles of making characters alive. Polygonal Modeling techniques: the Box, using Edit Mesh, Smoothing Techniques, Sudivision Surfaces. Nurbs Modelling techniques: Utilizing NURBS toolbox, surface points and CVs. Importing and attaching NURBS surfaces, rebuilding surfaces, curve and surface approximation. Graphic animation process: Camera & Animation Camera, Set & Background (Image Plane), Light Linking. Animation Techniques: Walk Cycle and Facial Expression using Blend Shape. Dynamics animation: Rigid Bodies, Soft Bodies, constraint, Particles. Tips and tricks on rendering. Concept of Rendering in 3D modeling. Render options and file output. Same as CSP 421.

Cyberpreneurship & Media Law (2 Units)

Introduction: Definition of creativity, innovation, examples of creativity leading to innovation, commercialization of creative and innovative ideas. Trends in technology development. Entrepreneurship management and ownership. Characteristics of entrepreneur, starting a new business, business planning, strategic planning & management, site selection and layout. Establishing new venture, risk management. Business Plan Development: definition, need, preparation of business plan. Forecasting developments and charting an action plan . Identifying the product/service, market research and feasibility study. Financing business. Sources of debt financing. Creating the marketing plan, pricing, creative advertising and promotion. Entrepreneurship case studies: Overview and analysis of successful entrepreneurs such as Bill Gates, Michael Dell, David Filo and Jerry Yang of Yahoo, etc. Nigerian Entrepreneurship: Discussion of Nigerian business environment, and illustrated with successful Nigerian entrepreneurs. Overview of the Nigerian Legal System: Civil and criminal. Basic concepts of law. Contract Law. . Current issues: digital signatures, Intellectual property and copyright. Speech Law: Defamation, Sedition, Printing Press Act. Speech on the Internet. Advertising Code: Made in Nigeria rules and guidelines, Advertising Standards. Media

and Licensing law in Nigeria: Developing an in-depth understanding of the nature and function of Nigerian media law. Public and Private licensing. Intellectual and moralrights. Music royalties, synchronization rights, performance rights. Role of music publishers. Broadcast rights, merchandising. Detailed analysis of Communications and Multimedia Act. Ethic and Etiquette: New codes of social behaviour: the right to privacy.

B. ENG. MECHANICAL ENGINEERING

		Lecture/Lab. Units
Course Summary		
(i)	**Core Courses**	
	Theory of Machines	6
	Workshop Practice	6
	Auto Workshop	3
	Engineering Drawing	4
	Thermodynamics	8
	Fluid Mechanics	8
	Mechanical Design	7
	Science and Engineering of Materials and } Metallurgy }	6
	Control Systems	3
	Manufacturing Technology	2
	Engineering Materials, Selection and } Economics }	3 1
	Engineer-in-Society	2
	Technology Policy and Development	2
	Technical Communications	3
	Advanced CAD/CAM	6
	Project	67
	Sub-Total:	
(ii)	**Other Courses**	10
	Electrical and Electronics Engineering	2
	Basic Civil Engineering	3
	Law and Management Courses	**15**
	Sub-Total	
(iii)	**Basic Science Courses**	20
	Mathematics	10
	Chemistry	10
	Physics	6
	Computers & Computing	**46**
	Sub-Total	
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	16
	General Studies	12
	Electives	**28**
	Sub-Total	
	Ground Total	**161**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	6
Engineering Mathematics	2
Computers & Computing	3
Theory of Machines I	2
Manufacturing Technology	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing	2
Workshop Practice	2
Engineering Metallurgy I	1
Engineer-in-Society	4
Elect. & Electronics Engineering	2
Civil Engineering	3
Control Systems	6
Laboratory Practicals	2
Foundation Course in Entrepreneurial Studies	**41**
Total	

400 Level	3
Theory of Machines II	2
Auto Workshop Practice	2
Thermodynamics	2
Fluid Mechanics	3
Mechanical Engineering Design I	2
Engineering Communication	2
Technology Policy and Development	2
Engineering Statistics	2
Introduction to Entrepreneurship Studies	3
Laboratory Practicals	**23**
Total	

500 Level	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy II	4
Mechanical Engineering Design II	3
Engineering Materials Selection, and Economics	6
Project	3
Law and Management	12
Electives	3
Advanced CAD/CAM	3
Laboratory Practicals	**40**
Total	

COURSE DESCRIPTIONS

Core Course Descriptions Common to 300, 400 and 500 Levels

(i) **Thermodynamics** **6 Credits**

Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) **Theory of Machines** **2 Credits**

Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton's Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) **Fluid Mechanics** **6 Credits**

Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy 3 Credits**

Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** **2 Credits**

Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** **7 Credits**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(vii) **Manufacturing Technology** **2 Credits**

Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** **2 Credits**

Workshop setting; Types of workshop equipment, machines and materials; Use of instruments, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** **3 Credits**

Control Engineering concepts; Transfer function; Differential Equation of control Systems; Transducers; Automatic control methods.

(x) **Engineering Statistics** **2 Credits**

Probability- elements of Probability, density and distribution functions, moments, standard distributions etc. Statistics – Regression and correlation, Large sampling theory. Test hypothesis and quality control. Introduction to Statistical Analysis Software packages.

B. ENG. ELECTRICAL AND ELECTRONICS ENGINEERING

		Lecture/Lab. Units
(a)	**Course Summary**	
	(i) **Humanities**	
	General Studies	16
	(ii) **Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
	Sub-Total	**36**
	(iii) **Entrepreneurial Studies**	4
	(iv) **Basic Engineering Courses**	
	Engineering Mathematics	12
	Computers & Computing	3
	Engineering Drawing	4
	Applied Mechanics	4
	Strength of Materials	2
	Material Science	3
	Thermodynamics	2
	Fluid Mechanics	2
	Basic Electrical Engineering	6
	Manufacturing Technology/Workshop Practice	2
	Engineer-in-Society	1
	Sub-Total	**41**
	(v) **Core Courses**	
	Engineering Mathematics	4
	Numerical Methods	4
	Electromagnetic Fields and Waves	6
	Circuit Theory	6
	Analogue Electronic Circuit	3
	Digital Electronic Circuit	3
	Physical Electronics	3
	Measurements and Instrumentation	3
	Communication Principles	3
	Electric Power Principles	3
	Electromechanical Devices & Machines	4
	Practicals	9
	Reliability Engineering	2
	Advanced Computer Programming & Statistics	3
	Control Engineering	2
	Advanced Circuit Techniques	2
	Final Year Project	4
	Electives	6
	Total	**73**
	(vi) **Options**	
	A choice of 20 Credits from any of the following courses	2
	Electromechanical Devices Design	2
	Electrical Services Design	
	Power Electronics and Drives	3

Power Systems Engineering (Systems Analysis, Planning and Protection)	2
Power Systems Communication and Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronics Design	
Micro-Computer Hardware and Software Techniques	3
	3
Communications Systems	2
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Telecommunication Services Design	2
Digital communication systems	2
Special topics in Engineering Technology in Electrical Engineering	
Total	**174**

(b) **Break-Down Of Courses Into Levels Of Study**
Core Courses 300 Level
(2 Semesters) And 400 Level (1 Semester): (3 Semesters)

	Lecture/Lab. Units
Engineering Mathematics	6
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Electronic Circuit (Analogue & Digital)	6
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electric Power Principles	3
Electromechnical Devices and Machines	4
Laboratory Practicals	9
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**60**
500 Level	
Reliability & Maintainability of Electrical & }	2
Electronic Components and Systems }	3
Advanced Computer Programming and Statistics	3
Control Engineering	2
Advanced Circuit Techniques	4
Project	6
Electives	**20**
Total	
Options	
A choice of 16 Credits from any of the following courses	2
Electromechanical Devices Design	2
Electrical Services Design	3
Power Electronics and Drives	

Power Systems Engineering (Systems Analysis,	3
Planning and Protection)	2
Power Systems Communication & Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronic Design	3
Micro-Computer Hardware and Software	3
Techniques	2
Communications Systems	2
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Digital communications system	2
Special Topics	
Telecommunication Services Design	

COURSE DESCRIPTIONS

Core Courses 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

(i) **Engineering Mathematics** **4 Credits**

Introduction to Partial differential equations. Fundamental equations of mathematical physics. Classification of quasilinear differential equations of the second order. Properly posed initial and boundary value problems for linear differential equations of the second order. Correctness of properly posed problems of mathematical physics. Problems in heat transfer (parabolic equation); wave propagation (hyperbolic equations); steady-state (elliptic equation). Problems in different co-ordinate systems, boundary value problems.

(ii) **Numerical Methods** **4 Credits**

Polynomials and their zeros – methods of bisection, Newton, Bairstow, synthetic division and Lehmer; Direct methods for the solution of linear equations; Iterative process, its application to the solution of simultaneous linear equations; convergence; interpolation and differentiation method in Numerical integration – Newton Coates formulae and finite difference methods; The eigen system problem Solution of ordinary differential equations – methods of Taylor, Euler, Predictor – Corrector and Runge-Kutta. Use of appropriate soft ware packages (e.g mathlab) should be encouraged.

(iii) **Electromagnetic Fields And Waves** **6 Credits**

Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell's equation (in rectangular co-ordinates and vector-calculus notation): Derivation of Maxwell's equations; electromagnetic potential and waves; Poynting vector; Boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media, Fundamentals of transmission lines, wave-guides and antennae.

(iv) **Circuit Theory** **6 Credits**

Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

(v) **Analogue Electronic Circuit** **3 Credits**

Review of single-stage transistor amplifiers using BJTS and EETs Equivalent circuit and calculation of current gain, voltage gain, power gain, in put and out put impedance. Operational Amplifiers: Parameters and applications. Feedback, Broadband and narrowed band amplifies. Power amplifiers. Voltage and current stabilizing circuit. Voltage amplifiers, multi storage amplifier. Using BJTs and FETs.

(vi) **Digital Electronics Circuit** **3 Credits**

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean Algebra. Simplification of Logic expressions using Karnaugh Method. Design combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counters, registers and timers. Switching and Waves shipping circuit. Generation of non sinusoidal signal (multi vibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc)

(vii) **Physical Electronics** **3 Credits**

Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(viii) **Measurements And Instrumentation 3 Credits**

General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impendance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital volumeters; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generators, function generators, wave analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(ix) **Control Theory** **3 Credits**

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(x) **Communication principles** **3 Credits**

Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(xi) **Electric Power Principles** **3 Credits**

Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line impendance, representation and per unit systems, relationship between currents and voltage; regulation of voltage, transmitted power and losses; construction of overhead lines and underground cables; power system equipment: standard and safety.

(xii) **Electrical Machines** **3 Credits**

Review of electromechanical energy conversion, rotating magnetic fields, performance and methods of speed control of DC machines, induction motors, linear induction motors, circle diagrams, power transformers, parallel operation of 3-phase transformers.

Performance of synchronous machines, parallel operation of synchronous generators, fractional horse-power motors, single-phase induction motors, universal motors. Reluctance motors, hysteresis motors. Faults on machines, methods of starting and protection of machines.

(xiii) **Practicals** **9 Credits**

Electrical Machines Laboratory:
A laboratory work on electrical machines designed to illustrate topics covered in Electromechanical Devices and Machines.

Telecommunication Laboratory
A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, turned circuits and active analogue filters.

Digital Electronics Laboratory
A laboratory work on digital electronics designed to illustrate topics covered in Electronic circuits.

Electronic Circuits Laboratory
A laboratory work on electronic circuits designed to illustrate topics covered in Electronic Circuits.

(xiv) **Engineering Mathematics** **2 Credits**
Linear Algebra – Elements of Matrices, determinants, Inverse of matrix, Theory of linear equations, eigenvalues and eigenvectors. Analytic geometry – co-ordinate transformation – solid geometry polar, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equation, Curve fitting. Simple linear programming, Fourier series – Euler coefficients, even and odd functions, Sine and cosine functions, Simple Applications. Gamma, Beta and probability functions.
Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems.
Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Rieman equations: Related theorems:
Laplace and Fourier transforms – Applications
Introduction to non-linear differential equations – stability and Applications.
Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc.
Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(b) **500 LEVEL**

(i) **Reliability Engineering** **2 Credits**
Introduction to Reliability, maintainability, availability, Elementary reliability theory. Application to power systems and electronic components. Test characteristics of electrical and electronic components. Types of fault. Designing for higher reliability. Packaging, Mounting, Ventilation. Protection from humidity, dust.

(ii) **Advanced Computer Programming And Statistics** **3 Credits**
Elements statistics: Distribution and experiements: Law of large number; Numerical iteration procedures, Revision of FORTRAN and BASIC in Engineering. Application programme in computer aided design of Electrical and Electronic systems.

(iii) **Control Engineering** **3 Credits**
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realisation of systems having specified transfer function, applications to circuit synthesis and signal processing.

(iv) **Advanced Circuit Techniques** **3 Credits**

Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops, Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(v) **Project** **6 Credits**

This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.

(vi) **Electives** **16 Credits**

These will be chosen by students with the Co-ordinators approval. The courses can be chosen from other programmes such as Mechanical Engineering, Physics and Mathematics/Computer Science.

The courses chosen should provide some breadth to the students chosen area of specialisation.

OPT 1 Electromechanical Devices Design **2 Credits**

Design of transformers, principles of AC and DC machine design, introduction to parks equations. .

OPT 2 Electrical Services Design **2 Credits**

Lighting installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables, protection of low voltage installation, and characteristics of low voltage equipment, Earthing and testing of electrical installation, illumination.

OPT 3 Power Electronics And Devices **3 Credits**

Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loades, analysis of circuits using transistors as switches, power control circuits, ACDC converters, characteristics of switching transformers, power semi-conductor device protection, examples of power electronic circuits, solar devices.

OPT 4 Power Systems Engineering **3 Credits**

Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

OPT 5 Power System Communication And Control 2 Credits

Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telementering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

OPT 6 Switchgear And High Voltage Engineering 2 Credits

Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightining protection, Electric cables and condensers.

OPT 7 Industrial Electronics Design 2 Credits
Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems.
Fire alarms, burglar alarms and general home and industrial instrumentation.

OPT 8 Micro-Computer Hardware And Software Techniques 3 Credits
Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes. Micro-processors, system architecture, bus control, instruction execution and addressing modes. Machine codes, assembly language and high-level language programming, Micro-processors as state machines. Microprocessor interfacing: Input/output. Technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters. System development tools: simulators, EPROM programming, assemblers and loaders, overview of a available microprocessor application.

OPT 9 Communications Systems 3 Credits
Microwave frequencies and uses; microwave tansmission in transmission lines and wave guides, microwave circuits; impendance transformation and matching, microwave circuits; passive microwave devices, resonant and filter circuits, active microwave devices; Klystron and magnetron tubes and semiconductor devices for microwave generation. Antennae: definitions of elementary parameters related to radiation patterns; dipole and operture antennae and the releated design parameters; introduction to antennae arrays. Radiowave propagation: propagation in the ionosphere, troposphere and in stratified media; principles of scatter propagation; applications in general broadcast, television and satellite communication systems. Radar systems nature of radar and radar equations; composition of a radar system; application of different types of radars.

OPT 10 Telecommunication Engineering 2 Credits
Cable telegraphy and telephony characteristics, cross talk, equation, Poleliness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

OPT 11 Analogue And Digital Computer 2 Credits
Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements: potentiometers, operational amplifiers, function generators, simulation of system transfer functions. Digital computer structure and elements, CPU, storage, peripherals Arithmetic processes, Hybrid computer systems.

OPT 12 Solid State Electronics 2 Credits
Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and eptitaxical material growth and impurity control, metal-semi-conductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

OPT 13 Digital Signal Processing 2 Credits
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and

software. Basic image processing concepts.

OPT 14 Digital Communications System 2 Credits

Block Diagram of digital communication system sampling theorem, Shannm theorem and applications in digital communication system. Advantages of digital signals . Noise in digital system. Filtering and equalisation. Digital modulation techniques: FSK, ASK, QPSK, M-PSK, QAM, etc. Error detection and correction techniques. Encoders/Decoders. Applications of digital communication system: Satellite communication, telephoning microwave, wireless communication, optical communication, Broadband. Communication. Internet Technology.

OPT 15 Special Topics 2 Credits

Topics in emerging technology in Electrical Energy – should be taught by one or more lecturers.

OPT 16 Telecommunication Services Design 2 Credits

Telephone installations, PABX installations choice of cables and accessories, computer networking: choice of cables , installations, accessories, optic fibre installations and accessories. Lighting protection techniques. Earthing techniques. Bill if Engineering material and Evaluation and billing of telecommunication installations

B. ENG. INDUSTRIAL AND PRODUCTION ENGINEERING

(a) **Course Summary**

		Lecture/Lab Units
(i)	**Core Courses**	
	Science & Eng. Of Materials and Metallurgy	10
	Operations Research	5
	Production Technology	6
	Mechanics of Machines	8
	Fluid Mechanics	5
	Industrial Engineering Statistics	4
	Thermodynamics	5
	Engineering Economics	4
	Engineering Drawing	6
	Workshop Practice including } Automobile workshop } Manufacturing Techniques/ } Workshop Practice }	2
	HFE and Factory Layout	5
	Machine Tools	5
	Project Planning and Control	6
	Mechanical Engineering Design	4
	Metrology	4
	Control systems	3
	Tool Design	3
	Industrial Computers and Applications	2
	Production Planning and Control	5
	Engineering Materials, Selection and Economics }	3
	Engineer-in-Society	1
	Technology Policy & Development	2
	Project	6
	Total	**104**
(ii)	**Other Courses**	
	Industrial Engineering	5
	Electronic & Electrical Engineering	10
	Law and Management	4
	Industrial Law	2
(iii)	**Basic Science Courses**	
	Mathematics	24
	Physics	10
	Chemistry	10
	Computers & Computing	3
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	12
	Sub-Total	**100**
	Grand Total	**204**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Engineering Mathematics	3
Computers & Computing	2
Theory of Machines	2
Operations Research	2
Manufacturing Technology	2
Thermodynamics	2
Fluid Mechanics	2
Industrial Engineering Statistics	1
Engineering Drawing	4
Workshop Practice	4
Metallurgy	6
HFE and factory Layout	2
Electrical & Electronic Engineering	2
Industrial Engineering	6
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**43**

400 Level

Operations Research	2
Engineering Economics	2
Project Planning and Control	2
Work Study and Systems Design	2
Industrial Process Design	2
Machine Tools	2
HFE and Factory Layout	2
Tool Design	2
Laboratory Practicals	1
Production Technology	2
Metrology	2
Introduction to Entrepreneurship Studies	2
Technical Communications	2
Total	25

500 Level

Industrial Computers and Applications	5
Engineering Metallurgy	2
Project Planning and Control	2
Mechanical Engineering Design	4
Works Study and Systems Design	2
Engineering Materials, Selection and Economics	3
Industrial Engineering Statistics	2
Machine Tools	3
Production and Inventory Design	2
Manufacturing Technology	5
Production Planning and Control	2
Project	6
Law and Management	4

Electives	6
Laboratory Practicals	6
Technology Policy & Entrepreneurship	2
Control Systems	3
Total	**59**

COURSE DESCRIPTIONS

(i) **Machine Tools**
Basic principles of machine tools Elements of machine tools.
Rigidity of machine tools. Kinematics of machine tolls. Jigs and Tool Design. Hydraulic and electrical transmissions in machines

(ii) **Meterology**
Meterology Laboratory setting. Various metrological experimental techniques. Applications of metrology. Control of metrology Labs.

(iii) **Production Technology**
Production process: Machining, Metal forming, Metal casting
Metal joining processes: welding, bracing, soldering, mechanical joining, adhesive joining, heat treatment and surface finishing processes

(iv) **Tool Designs**
Design of machine constructional elements. Tooling Design for Numerically controlled machines. Economics of machine tool design. Installation and Testing of machine tools. Machine tool maintenance. Design applications of jigs and fixtures

(v) **Operations Research**
Planning and progressing in the manufacturing industry, Linear programming techniques; Model formulations; maintainability and reliability procedures; Transportation and trans-shipment problems; Non-linear programming models.

(vi) **Engineering Economics**
Economics of business settings: Costing of production systems; objectives of cost analysis and cost control.

(vii) **Project Planning and Control**
Production planning; production control; Corporate Strategy and long range planning; project cost analysis and control.

(viii) **Work Study and Systems Design**
Method study and work measurement; work Study; time study; System design and optimisation.

(ix) **Industrial Process Design**
Process capability; process reliability measurement; process selection and design.

(x) **Human Factors Engineering and Factory Layout**
Factory layout models; Labour and time analysis; job evaluation; Workforce management and control; Training and incentives.

(xi) **Technical Communications**
Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing. 15 hrs (Teaching & demonstrations), 30hrs (Practicals)

B. ENG. PETROLEUM AND GAS ENGINEERING

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**General Studies**	16
		Sub-Total	16
	(ii)	**Basic Sciences**	
		Mathematics	20
		Chemistry	12
		Physics	10
		Geology	7
		Sub-Total	**49**
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Major Engineering Course**	
		(Petroleum Eng. Courses)	
		Introduction to Petroleum Eng.	3
		Drilling Courses	12
		Formation Evaluations	12
		Petroleum Production Engineering	12
		Reservoir Engineering	12
		Petroleum Economics	3
		Petroleum Eng. Laboratory	6
		Project	4
		Sub-Total	**64**
	(v)	**Other Engineering Courses**	
		Technical/Engineering Drawing	2
		Workshop Practice	2
		Strength of Materials	4
		Fluid Mechanics	6
		Thermodynamics	3
		Applied Electricity	4
		Computers & Computing	2
		Other Engineering Electives	5
			28
		Specialisation	12
	(vi)	**Components of Petroleum Engineering**	
		General Studies	16
		Basic Sciences	49
		Entrepreneurial Studies	4
		Major Engineering Courses	64
		Other Engineering Courses	28
		Specialisation	12
		Total	**173**

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5

(b) **Break-Down Of Courses Into Levels of Study**

	Lecture/Lab. Units
300 Level	
Industrial Studies	4
Engineering Economy	2
Engineering Analysis	5
Strength of Materials	3
Fluid Mechanics	3
Drilling Fluids Technology	4
Drilling Technology	3
Reservoir Engineering I	6
Petroleum Production Engineering I	3
Foundation Course in Entrepreneurial Studies	2
Petroleum Geology	3
Sub-Total	38
400 Level (I Semester)	
Industrial Studies	2
Applied Geophysics	2
Engineering Management and Law	2
Drilling Technology II	3
Reservoir Engineering II	3
Petroleum Production Engineering II	3
Well Lodging	3
Introduction to Entrepreneurship Studies	2
Sub-Total	**20**
500 Level	
Drilling Technology III	3
Reservoir Engineering III	3
Petroleum Refining Technology	3
Petroleum Production Engineering III	3
Reservoir Modeling and Simulation	3
Enhanced Oil Recovery	2
Project	4
Design	5
Petroleum Product Transport & Storage	2
Process Technology	3
Offshore Operations	2
Natural Gas Processing	3
Sub-Total	**36**

COURSE DESCRIPTIONS

300 Level

(i) **Industrial Studies** **2 Credits**

Introduction to the organisational structure of manufacturing organisations. Evolution of an industrial, domestic and commercial product from society's needs, or market survey; problem definition, design tools – simulation, graphs and layouts; feasibility studies. Team implementation/manufacture of selected simple engineering products-for industrial, domestic and commercial purposes.

(ii) **Industrial Studies II** **2 Credits**

Study of projects and contract documents for the various branches of Engineering; Drawing, Bill of Quantities, Identification of Materials, Material location, Quantity, Quality and handling requirements; Specification, Quality control and Measurements, Safety and Safety procedures.

(iii) **Engineering Economy** **2 Credits**

Introduction to Engineering Economy. Engineering Economy Concepts. Elementary Selections in Economic Analysis. Interest and Interest Formulas.Calculations of Interest Formulas and and the Engineering process, some Fundamental Economic Equivalence. Economic Analysis of Alternatives. Bases for Comparison. Decision Making among Alternatives. Evaluating Replacement Alternatives. Breakeven and Minimum Cost Analysis. The Evaluation of Public Activities. Accounting, Depreciation and Income Taxes. Accounting and Cost Accounting. Depreciation and Depreciation Accounting. Income Taxes in Economy Studies

(iv) **Heat and Mass Transfer** **4 Credits**

Models of heat transfer, general heat conduction equation, steady state conduction, unsteady heat transfer by convection, natural and forced, laminar and turbulent. Heat transfer by radiation, fundamentals of black and gray bodies, combined models of heat transfer, radiation exchange between surfaces. Heat exchangers, conductors and dryers. Mass transfer fundamentals, diffusion and convection mass transfer.

(v) **Strength of Materials I** **3 Credits**

Beams, Simple bending, Bending movement diagrams. Unsymmetrical bending. Shear centre. Composite beams plastic hinge. Beams in plastic range, continuous beams. Statically indeterminate systems, by elastic and plastic methods. Mohr's circle. Compound stresses. Buckling, Euler's Formular and Empirical Formulae. Energy Methods. Principles of Castigliano. Maxwell, Mohr. Applications.

(vi) **Strength of Materials II** **3 Credits**

Elementary concepts in two dimensional theory of elasticity-equations of equilibrium. Strain displacement relation. Generalised Hookes Law. Introduction to plastic behaviour of materials elastic, perfectly plastic and strain hardening materials. Linear Viscoelastic Materials. Thick walled pressure vessels. Stresses due to shrinkage fit.

(vii) **Engineering Analysis II** **3 Credits**

Statics of rigid bodies in three dimensions; Distributed Force-Centroids and Centres of Gravity; Analysis of Structures – Internal Forces, Newton's Third Law, Trusses, Frames, and Machines; Forces – moment of inertial – areas and masses; Rotation of rigid body about a fixed axis, plan motion of rigid body; Relative motion; Applications. Principles of virtual work, Efficiency of simple machines. Review and engineering applications of Differential Equations; Partial Differential Equations; Laplace Transformation and other transform methods. Series solutions and special functions such as Bessel's functions, Fourier series.

(viii) **Engineering Analysis III** **3 Credits**
Numerical methods and digital computer methods applied to various engineering problems including matrix inversion, numerical approximation methods, optimisation methods and applications in engineering: Introduction to state space formulation, analysis and applications. Computer design of simple engineering components and systems.

(ix) **Fluid Mechanics I** **3 Credits**
Fundamentals, physical characteristics and properties of fluids, viscosity, surface tension, pressure. Fluid statics, manometry, forces on submerged surfaces, bouyance and floatation, stability of floating bodies. Fluid masses subject to acceleration. Kinematics of Fluid motion, continuity equation, circulation and vorticity. Flow of ideal incompressible fluid, Euler's equation, Bernoulli's equation. Application of Bernoulli's equation and two dimensional flow systems. Impulse and momentum principle, elementary and simple flow machines applications. Some aspects of real flows, laminar and turbulent flow, flow in pipes, flow in open channels.

(x) **Fluid Mechanics II** **3 Credits**
Introduction to Hydrodynamics, stream function, flow fields, steam lined bodies, rotational and irrotational flows, velocity potential, conformal transformation. Jou Kowsky transformation. Thin aerofoil theory, characteristics of two dimensional aerofoil. Sections introduction to turbo - machines. Characteristics curves for pumps, axial flow machines, impulse and reaction turbines, fans, blowers and propellers. Introduction to gas dynamics. Introduction to boundary layer theory. Dimensional analysis and similarity laws

(xi) **Drilling Fluids Technology** **4 Credits**
Functions and composition of drilling fluids. Mud properties; testing, classification and chemical analysis. Drilling mud calculations, control of mud properties. Well completion fluids. Drilling mud performance.

(xii) **Drilling Technology I** **3 Credits**
Techiques for oil well drilling. Drilling rigs; equipment, hoisting , drill string, casing drill bits. Circulating system, drilling fluids, drilling hydraulics. Well head equipment. Drilling and casing programs. Drilling performance. Offshore drilling rigs.

(xiii) **Reservoir Engineering I** **6 Credits**
Fundamental properties of single and multiple fluid saturated rocks; porosity, permeability, relative permeability, fluid saturations, electrical resistivity capillary pressure. Surface forces, wettability, compressibility and correlations between rock properties.

(xiv) **Petroleum Production Engineering I 3 Credits**
Properties of oil and Gas: Composition of oil and natural gas; classification of crude oil; natural gas. Well Completion: Tubing; types, tubing equipment, uses of tubing, calculations; use of wirelines, packers-types, uses; multiple zone completion; well heads - casing and tubing hangers; Christmas tree. Cruptive Production: Gas-oil ratio (GOR); productivity index; fluid flow and pressure losses; multiphase formation volume factor (Bt). Perforation: bullet perforation; jet perforation. Artificial Production: Gas lift; pumps.

(xv) **Petroleum Geology** **3 Credit**
Petroleum prospecting, uses of geological data, reservoir rocks, reservoir fluids, traps, origin of oil and gas geology of the Niger Delta and Lake Chad Basin. Geophysics.

(xvi) **Petroleum Engineering Rock Mechanics 3 Credits**
Fundamentals of rock mechanics, Crater formation: Plastic and pseudo plastic characteristic of rocks load rate mechanism: Static and impact loading; tooth penetration as a function of differential and overburden pressures. Effect of differential pressure on drilling rate.

400 LEVEL

(i) **Industrial Studies III 2 Credits**
Group technology tasks: these may involve group design and manufacture of prepared drawings, specifications and planning schedules, a viable commodity which has a tested performance, and acceptable standard of finish and time and cost constraints, under a chosen leader; service and maintenance group tasks, etc. (Emphasis is for the students to appreciate the necessity to use people, materials and equipment to the best economic conditions and the need for personal relationship and the acceptance of responsibility when working as part of a team).

(ii) **Technical Communications 2 Credits**
Introduction to principles of effective communication with attention to the importance of emphasis, emotive content, and style; principles of technical writing, organisation and presentation of technical reports, feasibility studies, technical correspondence. Oral presentation of technical ideas; technical aids in presentation, organisation of practical applications.

(iii) **Engineering Management and Law 2 Credits**
Engineering profession: Professional ethics and conduct.
Law: Definition and specification; Applications of business law to engineering; Patents and inventions, trademarks and copyrights; Contracts and contract documents; Engineering business – types, the structure and functions of organisations: Professional problems – legal responsibilities, professional liability, role of engineer in law suits.
Management: Organisational structure and behaviour; engineer to engineer manager transition; Managerial functions, principles and techniques of planning, forecasting, organising technical activities; project selection and management; leadership, styles of leadership and management. Techniques in engineering management – motivated, appraisal, participative and control techniques.

(iv) **Drilling Technology II 3 Credits**
Pressure Control and Blowout Prevention: The need to control pressure; BOP valves; stack, choke line and choke manifold; choice of BOP system; control o kick; subsurface pressures and mud hydrostatic pressure; data for executing kick control; indications of kick; methods of circulating out a kick – Balanced Bottom Hole Pressure method (BBHP), driller's method; kick when tripping, gas out mud. Cementing: Equipment; hole conditions; volume calculations and rate of circulation; squeeze cementing; cement plug.
Fishing: Fishing tolls; objects lost in the hole; fishing methods.
Casing Design: Mechanical properties – tension, collapse and burst; designing a casing string.

(v) **Reservoir Engineering II 3 Credits**
Reservoir fluid behaviour, PVT analysis, formation volume factors. Estimating reserves; material balance equations. Concepts of fluid flow through porous media, Darcy's law. Steady state and transient fluid flow in reservoirs. Displacement of oil and gas. Reservoir testing and performance analysis. Differential equations for radial flow in a porous medium.

(vi) **Petroleum Production Engineering II 3 Credits**
Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and deemulsifiers; choice and dosage of de-emulsifiers. Separation and separators; heat treatment. Dehydration: need for dehydration of gas; dew-point depression; absorption with glycol and absorption with solids.

(vii) **Well Logging 3 Credits**
Well logging devices, principles and technology. Electrical, radioactive, acoustic/velocity, caliper, inclinometer, dipmeter and thermometer logs. Well log interpretation. Use of combination logs, cross plots. Production logging. Computer processing of logs. Measurements-while-drilling systems.

(viii) **Applied Geophysics and Petroleum Exploration 2 Credits**
The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostacy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

(ix) **Oil Pollution and Control 3 Credits**
Causes of oil pollution; blowout; pipeline and flowline leakages, sour-gas production, sea transportation hazards. Need for oil spill prevention and control; Impact on the environment – ecology. Methods of control; mechanical, chemical and biological methods. Global pollution problems; Government regulations.

500 Level

(i) **Drilling Technology III 3 Credits**
Drilling parameters: Choice of drilling program and drilling rig; mechanical parameters and their optimisation – drilling bits; hydraulic parameters – mud viscosity, density, filtrate and bit nozzles. Directional Drilling: Uses of directional drilling: deviating tools; vertical profile, horizontal profile; deviation measurements.
Offshore Drilling: Underwater BOP stack, marine risers, underwater well head, floater stability; heave compensators.

(ii) **Reservoir Engineering III 3 Credits**
Water influx; steady-state; pseudo steady – state (Hurst); transient (Van Everdingen and Hurst). Well test: drill-stem tests (DST); Production tests; pressure tests; back-pressure tests on gas wells, productivity tests on oil wells, build-up and draw-down tests on oil wells, coning of water and gas; effects of partial penetration. Secondary recovery; water injection sweep efficiency stiles methods, Dykstra – Parsons method.

(iii) **Petroleum Refining Technology 3 Credits**
Petroleum processing equipment; storage tanks; rectification columns; heat exchange apparatus; pipe fumances; pipelines and fittings; compressors and pumps. Preliminary processing. Thermal processes; thermal cracking; coking; pyrolysis. Catalytic processes; brief description; catalytic cracking; catalytic reforming; hydrogenation processes; hydrogen cracking.

(iv) **Petroleum Production Engineering III 3 Credits**
Problem-well analysis: Work over techniques; well stimulation; fracturing and acidising. Sand control: gravel packing; sand consolidation. Pipelines and transportation; maximum pipeline capacity; other transportation systems. Metering of oil and gas; problems associated with flow measurement; flow measurement systems; liquid level controllers.

(v) **Reservoir Modeling and Simulation 3 Credits**
Purpose of reservoir simulation. Concepts of Simulation; Darcy's law, fluid in porous media. Reservoir simulation equations. Finite – difference model. Solution of the simulator equations. Matrix of simultaneous equations; Data preparation: fluid data, rock data, production data, flow rate data. Making a simulation study. History matching.

(vii) **Enhanced Oil Recovery 3 Credits**
Principles of displacement: rock properties; fluid properties in reservoir; phase behaviour; displacement efficiencies. Gas methods; miscible slug; enriched gas-high pressure lean gas; carbon dioxide; nitrogen and other inerts. Chemical methods; miscellar – polymers; polymer augmented waterflood; permeability alteration; caustic. Thermal methods; steam stimulation; steam drive; in-situ combustion.

(vii) **Petroleum Product Transport and Storage 3 Credits**
Transportation of crude oil: Pipelines; tankers – loading and unloading techniques, offshore loading systems, international regulations on tanker transportation. Custody transfer storage of crude oil tank farm operations – gauging, sampling, quality control, underground storage – caverns, porous rocks. Gas transportation: compressors, piplines; liquefied natural gas transportation. Storage of natural gas; pressure tanks, re-injection in porous rocks, storage in caverns. Storage of LNG.

(viii) **Process Technology 3 Credits**
Pressure losses in pipes. Pressure losses in armature and fittings. Pumps. Heat exchangers. Nozzle theory and mass transfer. Combustion processes. Heat transfer, Conduction; convection; condensation, heat exchangers. Distillation. Particle fall in liquids cyclones.

(ix) **Offshore Operation 2 Credits**
Offshore drilling: Offshore prospecting; offshore rigs; stationary and floating rigs; rig movement and stability; drilling from a floating vessel; subsea BOP stack; marine risers; subsea wellhead. Offshore production: subsea well completion methods; offshore processing equipment and design; loading systems and other transportation. Offshore operations: logistics, contingency planning; oilspill and oil removal.

(x) **Natural Gas Processing 3 Credits**
Gas laws; phase behaviour of natural gas system; gas from condenstate and oil fields; field separation processes; dehydration and sweetening of natural gas; scale problems; gas liquification.

(x) **Petroleum Economics 2 Credits**
The structure of the petroleum industry; economic geography – impact of oil resources on the economy of oil producing countries; linear programming; refinery economics; oil concessions in Nigeria; government participation; the Nigeria petroleum labour market; marketing and sales calculations; investment analysis; risk analysis and probability; financing energy crisis.

(xii) **Multiple Phase Flow in Pipes 3 Credits**
Principles of two phase flow: The general energy equation; Evaluation of friction losses. Single phase Flow. Variables used in two phase flow; flow patterns. Horizontal flow: Horizontal pressure loss prediction methods. Prediction of horizontal flow patterns. Flow through restrictions.

B. ENG. METALLURGICAL AND MATERIALS ENGINEERING

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Core Courses**	
		Science and Engineering of Materials	5
		Fluid Mechanics	5
		Mechanics of Machines	5
		Engineering Drawing	6
		Workshop Practice (including Automobile Workshop)	2
		Thermodynamics	5
		Metallurgical Thermodynamics and Kinetics	2
		Manufacturing Technology	5
		Mechanical Processing of Materials	2
		Chemical Processing of Materials	2
		Mineral Processing and Technology	5
		Production Metallurgy	4
		Fuels, Refractories and Furnace Technology	2
		Extraction and refining of materials	4
		Metallurgical and Materials Process Design	9
		Non-Metals Technology	4
		Foundry Technology	6
		Heat and Mass Transfer	3
		Thermal Treatment Materials	3
		Corrosion Engineering	2
		Powder Technology	2
		Physical Metallurgy	2
		Engineer-in-Society	2
		Technology Policy and Development	2
		Project	6
		Engineering Materials Selections and Economics	3
		Other Materials & Metallurgy Laboratories	6
		Total	**104**
	(ii)	**Other Courses**	
		Electronic & Electrical Engineering Courses	10
		Basic Chemical Engineering	5
		Law and Management	4
	(iii)	**Basic Science Courses**	
		Mathematics	24
		Physics	10
		Chemistry	10
		Computers & Computing	3
	(iv)	**Entrepreneurial Studies**	4
	(v)	**Humanities**	
		General Studies	16
		Electives	8
		Total	**94**
		Grand Total	**198**

(b) **Break-Down Of Courses Into Levels Of Study**

	6
300 Level	2
Engineering Mathematics	2
Computers & Computing	2
Manufacturing Technology	2
Metallurgical Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing & Computer Aided Graphics	1
Workshop Practice	2
Engineer-in-Society	4
Foundry Technology	3
Materials Electives (Non-Metals)	2
Minerals Processing and Technology	3
Fuels, Refractories & Furnace Technology	2
Electrical and Electronics Engineering Courses	2
Basic Chemical Engineering Courses	3
Introduction to Deformation Processes	2
Laboratory Practicals	**42**
Foundation Course in Entrepreneurial Studies	
Total	
400 Level	
Extraction and Refining of Materials	2
Mechanical Processing of Materials	2
Chemical Processing of Materials	2
Production Metallurgy I	2
Materials & Metallurgical Laboratories	2
Metallurgical & Materials Process Design	3
Foundry Technology	3
Corrosion Engineering	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**25**
500 Level	
Mineral Processing and Technology	2
Metallurgical Thermodynamics & Kinetics	2
Powder Technology	2
Production Metallurgy II	2
Extraction and Refining of Materials	2
Metallurgical & Materials Process Design	4
Heat and Mass Transfer	3
Thermal Treatment of Materials	3
Physical Metallurgy	2
Project	6
Law	2
Engineering Materials Selection & Economics	3
Other Materials & Metallurgical Laboratories	4
Technology Policy and Development	2
Production & Financial Management	2
Materials Electives (Non Metals)	2
Laboratory Practicals	3
Total	**44**

Electives

- Wood Product Engineering
- Polymer Science Technology
- Ceramics & Glass Technology
- Composite Materials
- Plastic Engineering

COURSE DESCRIPTIONS

(i) **Thermodynamics** **6 Credits**

Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) **Theory of Machines** **2 Credits**

Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton's Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) **Fluid Mechanics** **6 Credits**

Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy 3 Credits**

Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** **2 Credits**

Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** **7 Credits**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(vii) **Manufacturing Technology** **2 Credits**

Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** **2 Credits**

Workshop setting; Types of workshop equipment, machines and materials; Use of instruments and tools, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** **3 Credits**

Control Engineering concepts; Transfer function; Differential Equation of control Systems; Transducers; Automatic control methods.

(x) **Engineering Statistics** **2 Credits**

Probability- elements of Probability, density and distribution functions, moments, standard distributions etc.

Statistics - Regression and correlation, Large sampling theory. Test hypothesis and quality control. Introduction to Statistical Analysis Software packages.

(xi) **Process Technology And Design 9 Credits (400 & 500 Levels)**
Mineral Processing and Technology, Extraction and Refining of materials; Non-metals; Foundry, Fuels, Refractions and Furnaces; Thermal Treatment of materials; Metallurgical and Materials process design.

(xii) **Heat And Mass Transfer 2 Credits (500 Level)**
Analogue between convective heat and mass transfer; Secondary surfaces; Heat transfer with phase change.

(xiii) **Corrosion Engineering 2 Credits (400 Level)**
Aqueous corrosion; Environmental aspects of corrosion; Oxidation and metals. Corrosion control.

(xiv) **Instrumentation 9 Credits**
Instrumentation methods of analysis; Dynamics of process and equipment; Controllers and their applications; Computer methods.

B. ENG. MINING AND MINERALS PROCESSING ENGINEERING

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i) **Core Courses**		
	Mechanics of Machines		5
	Thermodynamics		4
	Fluid Mechanics		4
	Engineering Drawing		4
	Workshop Practice		2
	Science and Engineering of Materials		
	}		10
	And Metallurgy		5
	}		6
	Manufacturing Technology		5
	Geology		6
	Mineral Processing and Technology		4
	Mine Surveying		9
	Mining Process Design		3
	Mining Systems		3
	Rock Mechanics		4
	Explosive		2
	Mine Ventilation		3
	Mine Health and Safety		
	Plant Technology		3
	Engineering Materials Selection	}	6
	And Economics	}	2
	Project		1
	Technology Policy and Development		**91**
	Engineer-in-Society		
	Total		
	(ii) **Other Courses**		
	Electrical/Petroleum/Civil Engineering		
	Law and Management		20
			4
	(iii) **Basic Science Courses**		
	Mathematics		
	Physics		24
	Chemistry		10
	Computers & Computing		10
			3
	(iv) **Entrepreneurial Studies**		
			4
	(v) **Humanities**		
	General Studies		16
	Electives		0
	Total		**93**
	Grand Total		**188**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	3
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy	2
Engineering Drawing	2
Workshop Practice	2
Engineer-in-Society	1
Manufacturing Technology	2
Electrical & Electronic Engineering	3
Civil Engineering Courses	3
Mine Surveying	3
Mining Systems	3
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**38**
400 Level	
Geology	3
Mining Systems	3
Mine Surveying	3
Drilling and Blasting	3
Mining Process Design	2
Plant Technology	3
Engineering Communications	2
Laboratory Practicals	6
Total	**25**
500 Level	
Geology	3
Mining System	3
Petroleum Engineering	3
Mining Process Design	2
Mine Ventilation	3
Mine Health and Safety	2
Rock Mechanics	3
Engineering Metallurgy	2
Mineral Processing Technology	3
Engineering Materials, Selection and Economics	3
Project	6
Technology Policy & Development	2
Law and Management	3
Laboratory Practicals	3
Total	**41**

COURSE DESCRIPTIONS

(i) See courses decriptions Common to all Levels

(ii) **Geology** **6 Credits**

(400 & 500 Levels)

Elements of physical geology; Structural geology; Paleontology and Stratigraph; Mineralogy; Petrology; Geochemistry; Sedimentology; Geophysical prospecting methods, Photogeology; Hydro geology

Structure and history of the earth and the solar system. Rocks and minerals: origin, distribution, diagnostic features and classification. Energy and water resources. Introduction to geophysical prospecting methods. Interpretation of geophysical data. Characteristics of the earth's atmosphere. Atmospheric variables and methods of measurement. weather systems and forecasting. Climate and climatic change. Development of mining technology. States in the life of a mine. Unit operations in mining. Mining and its consequences. Government influence and regulations.

(iii) **Mineral Processing and Technology** **3 Credits**

(500 Level)

Properties of single particles and particle systems; Transport properties; Mass and momentum transfer; Cost analysis and control in mineral processing; Applications of operational research techniques. Structures and textures of Mineral and their significance in Mineral genesis and treatment. Ore analysis: Qualitative and quantitative assaying and Mineralogical analysis. Basic comminution theory, comminution and liberation. Particle sizing: sizing by screening, sizing by classification, particle size analysis. Mineral concentration techniques e.g: Heavy medium separation, magnetic and other separation techniques including the physical and mechanical processes of agglomeration. Preparation of Metallurgical mass balance: recovery and metallurgical losses.

Dewatering: flocculation and dispersion, theory and practice of thickening, filtration and drying. Ore sampling techniques. Communition theory. Criteria for selection of grinding and screening equipment for mineral concentration techniques. Selection of mineral concentration techniques. Selection of mineral concentration equipment. Design, testing and evaluation of mineral beneficiation flow sheets for copper, tin, lead, zinc, iron, gold and other ores of local importance. Materials handling methods. Tailings disposal.

(iv) **Mine Surveying** **6 Credits**

(300 & 400 Levels)

Basic land surveying theory and practice; Mine Surveying; Applications; Setting out and typical calculations.

Mining theodolite. Unique difference between mining theodolite and land surveying theodolite. Surveying in open cast mines – building and construction of an open cast deposit, calculation for drilling, blasting, excavation, transport operations and drainage. Mine survey control in support and stability of slopes in quarry/open pit mines. Factors affecting stability and deformation of slopes in quarry or open pit mines. Methods of calculation of angle of slope in quarry or open pit mines. Surveying in underground mine systems – control on industrial layout of underground deposits. Construction of shaft and shaft lift; mine survey work on contact with mineral surface (lava). Geometrical projections of mine rocks and other mine features. Geometrical classification of industrial and non-industrial mineral deposit. Parameters of mineral reserve estimation and methods of quantifying mineral reserve. Concept of displacement in underground mining zone. Process of displacement of mine rooks/earth surface. Basic understanding and parameters that characterise the process of rock/earth/displacement. Factors affecting rock displacement in mineral deposit. Mine survey control on displacement of mine rock/earth surface. Application of photogrammetry in mining. Computer application in mineral industry. Field work.

(v) **Mining Systems** **9 Credits**
(300, 400 & 500 Levels)
Surface mining operations; Design of surface mining systems; Surface excavation; Ore handling equipment; Case studies of typical surface mines; Underground mining operations; Tunnelling; Underground mining methods; Handling and haulage; Hydraulic transport and pipeline systems.
Analysis of elements of surface mine operation. Design of surface mining systems with emphasis on minimisation of adverse environmental impact and maximization of efficient use of mineral resources. Surface excavation. Ore estimates, grade control, short and long range planning, unit operations, equipment selection, cost estimation, slope stability and placer mining operation. Ore handling equipment. Case studies of typical surface mines: coal, metallic and non-metallic mines. One or more field trips to operating mines scheduled.

Selection, design and development of most suitable underground mining methods based on the physical and geological properties of mineral deposits. Unsupported and supported underground mining methods. Conservation and environmental systems and equipment, conveyors, cable rope-ways and rope haulage, trackless mining systems, hydraulic transport and pipeline systems. Calculations of ore reserve estimates, development planning and preparations for development and extraction, construction of development openings. Cases studies of typical underground mines: coal, metallic and non-metallic. Field trip(s) to operating mines scheduled.

(vi) **Rock mechanics** **3 Credits**
(500 Level)
Mechanical properties of soils and rocks; Failure prediction methods; Mechanics of mine support and roof control.
Introduction to Rock Mechanics – Definition of terms and importance of rock mechanics; field applications in Mining, Civil and Petroleum Engineering. Classification and Index properties of rocks – Geological classification of rocks (crystalline rocks, organic rocks); Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; Classification of rock masses for engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Triaxial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; The meaning of rock strength; Application of the complete Stress-Strain curve. The Mohr Coulomb failure criterion; The effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulom-Navier criterion of failure of rocks; Griffth brittle failure Criterion. Elastic properties. Applications of rock mechanics in engineering or underground openings. Rock slope stability. Support systems design and selection – caving and subsidence. Observation of mass deformations – extensometers and strain transducers. Case studies.

(vii) **Drilling & Blasting** **3 Credits**
(400 Level)
Types and properties of explosives; Applications of explosives in rock drilling, boring; and mechanical breakage; Safety consideration in the use of explosives.
Rock characteristics affecting drilling - engineering properties of rock material, rock drillability and blastability. Classification of drilling and penetration methods. Theories of rock penetration. Rotary, percussive, rotary-percussive and thermal drilling. Drill bits and their applications. Diamond drilling and ore recovery. Basic parameters affecting bench drilling-bench height, burden, spacing and drilling pattern. Choice of drilling equipment. Definition of explosives.
Brief history of explosives. Terminology and definition – velocity of detonation, density, detonation pressure, sensitivity, strength, water resistance, fume characteristics. Properties and classification of explosives – dynamites, ammonium nitrate and fuel oil (ANFO). Explosive accessories. Magazine construction. Blasting methods and practice

in surface and underground mines. Blasting patterns; special blasting techniques – smooth, pre-splitting, secondary blasting procedure. Disturbances created by blasting.

(viii) **Mining Process Design** **4 Credits**
(400 & 500 Levels)
Sequence in mining systems; Design of mining process elements and layouts; Safety and control systems; Support system design.
Design of the following mine structures such as access to mineral deposits. Mine layout, surface mine excavation methods. Underground mine excavation methods, drilling and blasting patterns. Underground roof supports, mine drainage system, mine ventilation network, mine transportation system and explosives magazines etc. This course basically involves drawing. Students are expected to provide necessary drawing tools such as drawing pens standard drawing papers, etc.

(ix) **Mine Ventilation** **3 Credits**
(500 Level)
Effects and changes of poor mine ventilation;
Air systems design; Mine ventilation design and control.
Fundamentals of mine ventilation. Techniques for the control of dust, temperature, humidity, gas. Physiological effects and dangers of poor mine ventilation. Basic principles of mine ventilation design. Simple calculations of flow of air through ducts and mine opening. Equipment selection, instrumentation and air measurements. Evaluation of efficiency of ventilation systems.

(x) **Mine Health and Safety** **2 Credits**
(500 Level)
Causes and prevention of mine accidents. Mine rescue procedures. Mine health and safety regulations. Design of safety systems for typical surface and underground mines. Basic concepts of systems safety engineering. Mine health and safety systems.

(xi) **Plant Technology** **3 Credits**
(400 Level)
Plant and process control; Mining machinery, operations; Plant maintenance.
Essential features of a machine: gears, shaft bearings, couplings etc. Construction and application of wire rope used in mine machinery. Care of ropes. Lubricants for mine machinery.

Surface mine Machinery: Power shovel, front-end-loaders, dragline, hydraulic excavators, bucket wheel excavators, bucket change excavators, rippers, scrapers and bulldozers. Dredge monitors and gravel pumps, sluice boxes, dump trucks. Underground mine machinery: Loaders – gathering arm loaders, bucket type loaders, front-end-loaders, load-and slucher hoist.

Transports: locomotives-battery, trolley wire and diesel conveyor belts haulage trucks, rope haulage-direct and endless rope. Hosting, Types of pumps and their application. Pumps characteristics compressors-reciprocating and rotary types, characteristic s and choice of compressors.

B. ENG. MECHATRONICS ENGINEERING

		Lecture/Lab. Units
(a)	**Course Summary**	
	(i) **Humanities**	
	General Studies	16
	(ii) **Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
	Sub-Total	**36**
	(iii) **Entrepreneurial Studies**	4
	(iv) **Basic Engineering Courses**	
	Engineering Mathematics	12
	Computers & Computing	3
	Engineering Drawing	4
	Applied Mechanics	4
	Strength of Materials	2
	Material Science	3
	Thermodynamics	2
	Fluid Mechanics	2
	Basic Electrical Engineering	6
	Manufacturing Technology/Workshop Practice	2
	Engineer-in-Society	1
	Sub-Total	**41**
	(v) **Core Courses**	
	Engineering Mathematics	4
	Numerical Methods	4
	Electromagnetic Fields and Waves	6
	Circuit Theory	6
	Analogue Electronic Circuit	3
	Digital Electronic Circuit	3
	Physical Electronics	3
	Measurements and Instrumentation	3
	Communication Principles	3
	Electric Power Principles	3
	Electromechanical Devices & Machines	4
	Practicals	9
	Reliability Engineering	2
	Advanced Computer Programming & Statistics	3
	Control Engineering	2
	Advanced Circuit Techniques	2
	Final Year Project	4
	Electives	6
	Total	**73**
	(vi) **Options**	
	A choice of 20 Credits from any of the following courses	2 2
	Electromechanical Devices Design	
	Electrical Services Design	

Power Electronics and Drives	3
Power Systems Engineering (Systems Analysis, Planning and Protection)	2
Power Systems Communication and Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronics Design	
Micro-Computer Hardware and Software	3
Techniques	3
Communications Systems	2
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Telecommunication Services Design	2
Digital communication systems	2
Special topics in Engineering Technology in Electrical Engineering	
Total	**174**

(b) **Break-Down Of Courses Into Levels Of Study**
Core Courses 300 Level
(2 Semesters) And 400 Level (1 Semester): (3 Semesters)

	Lecture/Lab. Units
Engineering Mathematics	6
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Electronic Circuit (Analogue & Digital)	6
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electric Power Principles	3
Electromechnical Devices and Machines	4
Laboratory Practicals	9
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**60**
500 Level	
Reliability & Maintainability of Electrical & }	2
Electronic Components and Systems }	3
Advanced Computer Programming and Statistics	3
Control Engineering	2
Advanced Circuit Techniques	4
Project	6
Electives	**20**
Total	
Options	
A choice of 16 Credits from any of the following courses	2
Electromechanical Devices Design	2
Electrical Services Design	3

Power Electronics and Drives	
Power Systems Engineering (Systems Analysis,	3
Planning and Protection)	2
Power Systems Communication & Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronic Design	3
Micro-Computer Hardware and Software	3
Techniques	2
Communications Systems	2
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Digital communications system	2
Special Topics	
Telecommunication Services Design	

COURSE DESCRIPTIONS

Core Courses 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

(vi) **Engineering Mathematics** **4 Credits**

Introduction to Partial differential equations. Fundamental equations of mathematical physics. Classification of quasilinear differential equations of the second order. Properly posed initial and boundary value problems for linear differential equations of the second order. Correctness of properly posed problems of mathematical physics. Problems in heat transfer (parabolic equation); wave propagation (hyperbolic equations); steady-state (elliptic equation). Problems in different co-ordinate systems, boundary value problems.

(vii) **Numerical Methods** **4 Credits**

Polynomials and their zeros – methods of bisection, Newton, Bairstow, synthetic division and Lehmer; Direct methods for the solution of linear equations; Iterative process, its application to the solution of simultaneous linear equations; convergence; interpolation and differentiation method in Numerical integration – Newton Coates formulae and finite difference methods; The eigen system problem Solution of ordinary differential equations – methods of Taylor, Euler, Predictor – Corrector and Runge-Kutta. Use of appropriate soft ware packages (e.g mathlab) should be encouraged.

(viii) **Electromagnetic Fields And Waves** **6 Credits**

Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell's equation (in rectangular co-ordinates and vector-calculus notation): Derivation of Maxwell's equations; electromagnetic potential and waves; Poynting vector; Boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media, Fundamentals of transmission lines, wave-guides and antennae.

(ix) **Circuit Theory** **6 Credits**

Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

(x) **Analogue Electronic Circuit** **3 Credits**

Review of single-stage transistor amplifiers using BJTS and EETs Equivalent circuit and calculation of current gain, voltage gain, power gain, in put and out put impedance. Operational Amplifiers: Parameters and applications. Feedback, Broadband and narrowed band amplifies. Power amplifiers. Voltage and current stabilizing circuit. Voltage amplifiers, multi storage amplifier. Using BJTs and FETs.

(vi) **Digital Electronics Circuit** **3 Credits**

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean Algebra. Simplification of Logic expressions using Karnaugh Method. Design combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counters, registers and timers. Switching and Waves shipping circuit. Generation of non sinusoidal signal (multi vibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc)

(vii) **Physical Electronics** **3 Credits**

Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(viii) **Measurements And Instrumentation 3 Credits**

General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impendance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital volumeters; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generators, function generators, wave analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(ix) **Control Theory** **3 Credits**

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(x) **Communication principles** **3 Credits**

Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(xi) **Electric Power Principles** **3 Credits**

Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line impendance, representation and per unit systems, relationship between currents and voltage; regulation of voltage, transmitted power and losses; construction of overhead lines and underground cables; power system equipment: standard and safety.

(xii) **Electrical Machines** **3 Credits**

Review of electromechanical energy conversion, rotating magnetic fields, performance and methods of speed control of DC machines, induction motors, linear induction motors, circle diagrams, power transformers, parallel operation of 3-phase transformers.

Performance of synchronous machines, parallel operation of synchronous generators, fractional horse-power motors, single-phase induction motors, universal motors. Reluctance motors, hysteresis motors. Faults on machines, methods of starting and protection of machines.

(xiii) **Practicals** **9 Credits**

Electrical Machines Laboratory:
A laboratory work on electrical machines designed to illustrate topics covered in Electromechanical Devices and Machines.

Telecommunication Laboratory
A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, turned circuits and active analogue filters.

Digital Electronics Laboratory
A laboratory work on digital electronics designed to illustrate topics covered in Electronic circuits.

Electronic Circuits Laboratory
A laboratory work on electronic circuits designed to illustrate topics covered in Electronic Circuits.

(xiv) **Engineering Mathematics** **2 Credits**
Linear Algebra – Elements of Matrices, determinants, Inverse of matrix, Theory of linear equations, eigenvalues and eigenvectors. Analytic geometry – co-ordinate transformation – solid geometry polar, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equation, Curve fitting. Simple linear programming, Fourier series – Euler coefficients, even and odd functions, Sine and cosine functions, Simple Applications. Gamma, Beta and probability functions.
Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems.
Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Rieman equations: Related theorems:
Laplace and Fourier transforms – Applications
Introduction to non-linear differential equations – stability and Applications.
Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc.
Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(b) **500 LEVEL**

(vii) **Reliability Engineering** **2 Credits**
Introduction to Reliability, maintainability, availability, Elementary reliability theory. Application to power systems and electronic components. Test characteristics of electrical and electronic components. Types of fault. Designing for higher reliability. Packaging, Mounting, Ventilation. Protection from humidity, dust.

(viii) **Advanced Computer Programming And Statistics** **3 Credits**
Elements statistics: Distribution and experiements: Law of large number; Numerical iteration procedures, Revision of FORTRAN and BASIC in Engineering. Application programme in computer aided design of Electrical and Electronic systems.

(ix) **Control Engineering** **3 Credits**
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realisation of systems having specified transfer function, applications to circuit synthesis and signal processing.

(x) **Advanced Circuit Techniques** **3 Credits**

Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops, Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(xi) **Project** **6 Credits**

This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.

(xii) **Electives** **16 Credits**

These will be chosen by students with the Co-ordinators approval. The courses can be chosen from other programmes such as Mechanical Engineering, Physics and Mathematics/Computer Science.

The courses chosen should provide some breadth to the students chosen area of specialisation.

OPT 1 Electromechanical Devices Design **2 Credits**

Design of transformers, principles of AC and DC machine design, introduction to parks equations. .

OPT 2 Electrical Services Design **2 Credits**

Lighting installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables, protection of low voltage installation, and characteristics of low voltage equipment, Earthing and testing of electrical installation, illumination.

OPT 3 Power Electronics And Devices **3 Credits**

Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loades, analysis of circuits using transistors as switches, power control circuits, ACDC converters, characteristics of switching transformers, power semi-conductor device protection, examples of power electronic circuits, solar devices.

OPT 4 Power Systems Engineering **3 Credits**

Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

OPT 5 Power System Communication And Control 2 Credits

Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telementering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

OPT 6 Switchgear And High Voltage Engineering 2 Credits

Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightining protection, Electric cables and condensers.

OPT 7 Industrial Electronics Design 2 Credits
Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems.
Fire alarms, burglar alarms and general home and industrial instrumentation.

OPT 8 Micro-Computer Hardware And Software Techniques 3 Credits
Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes. Micro-processors, system architecture, bus control, instruction execution and addressing modes. Machine codes, assembly language and high-level language programming, Micro-processors as state machines. Microprocessor interfacing: Input/output. Technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters. System development tools: simulators, EPROM programming, assemblers and loaders, overview of a available microprocessor application.

OPT 9 Communications Systems 3 Credits
Microwave frequencies and uses; microwave tansmission in transmission lines and wave guides, microwave circuits; impendance transformation and matching, microwave circuits; passive microwave devices, resonant and filter circuits, active microwave devices; Klystron and magnetron tubes and semiconductor devices for microwave generation. Antennae: definitions of elementary parameters related to radiation patterns; dipole and operture antennae and the releated design parameters; introduction to antennae arrays. Radiowave propagation: propagation in the ionosphere, troposphere and in stratified media; principles of scatter propagation; applications in general broadcast, television and satellite communication systems. Radar systems nature of radar and radar equations; composition of a radar system; application of different types of radars.

OPT 10 Telecommunication Engineering 2 Credits
Cable telegraphy and telephony characteristics, cross talk, equation, Poleliness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

OPT 11 Analogue And Digital Computer 2 Credits
Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements: potentiometers, operational amplifiers, function generators, simulation of system transfer functions. Digital computer structure and elements, CPU, storage, peripherals Arithmetic processes, Hybrid computer systems.

OPT 12 Solid State Electronics 2 Credits
Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and eptitaxical material growth and impurity control, metal-semi-conductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

OPT 13 Digital Signal Processing 2 Credits
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and

software. Basic image processing concepts.

OPT 14 Digital Communications System 2 Credits

Block Diagram of digital communication system sampling theorem, Shannm theorem and applications in digital communication system. Advantages of digital signals . Noise in digital system. Filtering and equalisation. Digital modulation techniques: FSK, ASK, QPSK, M-PSK, QAM, etc. Error detection and correction techniques. Encoders/Decoders. Applications of digital communication system: Satellite communication, telephoning microwave, wireless communication, optical communication, Broadband. Communication. Internet Technology.

OPT 15 Special Topics 2 Credits

Topics in emerging technology in Electrical Energy – should be taught by one or more lecturers.

OPT 16 Telecommunication Services Design 2 Credits

Telephone installations, PABX installations choice of cables and accessories, computer networking: choice of cables , installations, accessories, optic fibre installations and accessories. Lighting protection techniques. Earthing techniques. Bill if Engineering material and Evaluation and billing of telecommunication installations

B. ENG. AGRICULTURAL AND BIO-RESOURCES ENGINEERING

Course Title		Lecture/Lab. Units
(i)	**General Studies**	16
(ii)	**Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
(iii)	**Entrepreneurial Studies**	4
	Sub-Total	**50**
(iv)	**Management and Humanities**	
	Economics	2
	Principles of Management	3
	Farm Management, Rural Sociology	
and	Agric. Extension	2
	Technical Communication	2
	Engineer-in-Society	1
	Sub-Total	**10**
(v)	**Basic Agriculture**	
	Animal Production	3
	Crop Production	3
	Soil Science	2
	Sub-Total	8
(vi)	**Engineering Mathematics & Statistics, Computers & Computing**	9
	Engineering Mathematics & Statistics	2
	Computers & Computing	2
	Information Technology in Engineering	**13**
	Sub-Total	
(vii)	**Basic Engineering**	
	Basic Electrical Engineering	3
	Applied Mechanics	3
	Engineering Drawing	2
	Machine Drawing and Design	2
	Fluid Mechanics	2
	Hydraulics	2
	Hydrology	3
	Geology for Engineers	2
	Metallurgy	2
	Strength of Materials	2
	Materials Science	2
	Manufacturing Tech/Workshop	2
Practice		2
	Thermodynamics	6
	Laboratory Practicals	**35**
	Sub-Total	

Core Courses

(viii)	**Agricultural and Bio-Resources Engineering**	2
	Basic Agric. & Bio-Res. Engineering	3
	Farm Power and Machinery	3
	Irrigation and Drainage	
	Properties, Handling, Processing and	2
	Storage of Agricultural Materials	3
	Land Surveying	2
	Land Clearing and Development	3
	Soil and Water Conservation	3
	Farm Electrification	
	Farm Structures and Environmental	3
	Control	2
	Agric. Mechanisation	2
	Workshop Practice	7
	Laboratory Practicals	6
	Final Year Project	**41**
	Sub-Total	

(ix)	**Specialisation and Electives** (Up to 20 Credits selected from any of the three options)	**Lecture/Lab. Units**
	Crop Processing and Storage Option:	3
	Advanced Thermodynamics	
	Engineering Properties and Handling	3
of	Agric. Materials	
	Processing and Storage of Agric.	3
	Materials	
	Solar Energy Applications to	2
Processing	and Storage	3
	Agric. Machinery	2
	Mechanics of Deformable Bodies	3
	Design of Agric. Machines	2
	Food Engineering	2
	Farm Transportation	2
	Automotive Service and Maintenance	3
	Industrial Studies	28
	Sub-Total	
	Farm Power and Machinery Option:	
	Agric. Power	3
	Agric. Machinery	3
	Mechanics of Deformable Bodies	2
	Design of Agric. Machines	3
	Operations and Management of Farm	
	Power and Machinery Systems	2
	Farm Transportation	2
	Engineering Properties and Handling	
	of Agric. Materials	3
	Processing and Storage of Agric.	
	Materials	3
	Food Engineering	2
	Automotive Service and Maintenance	2
	Industrial Studies	3
	Sub - Total	**28**

Soil and Water Engineering Option:

Irrigation	3
Agricultural Land Drainage	2
Advanced Hydraulics	3
Rural Water Supply and Sanitation	2
Design of Irrigation and Soil Conservation Structures	3
Environmental Engineering	3
Foundation Engineering	3
Farm Transportation	2
Automotive Service and Maintenance	2
Industrial Studies	3
Sub - Total	26

Grand Total **174 to 177**

Break-down of Courses into Levels of Study:

300 Level

Course Title	**Lecture/Lab. Units**
Engineering Mathematics	6
Basic Agric. & Bio-Res. Engineering	2
Land Surveying	3
Hydrology	3
Geology for Engineers	2
Machine Drawing and Design	2
Hydraulics	2
Metallurgy	2
Mechanics of Machines	2
Soil Mechanics	2
Soil Science	2
Animal Production	3
Crop Production	3
Technical Communication	2
Foundation Courses in Entrepreneural Studies	2
Laboratory Practicals	3
Sub-Total	41

400 Level

Course Title	**Lecture/Lab. Units**
Engineering Mathematics & Statistics	3
Farm Power and Machinery	3
Irrigation and Drainage	3
Farm Structures and Environmental Control	3
Properties, Handling, Processing and Storage of Agric. Materials	3
Farm Management, Rural Sociology and Agric. Extension	2
Economics	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**21**

500 Level

Principles of Management	3
Farm Electrification	3
Soil and Water Conservation	3
Land Clearing and Development	2
Agric. Mechanisation	2
Final Year Project	6
Sub-Total	19
Specialisation and Electives from any of the three options	17 to 20
Sub-Total	36 to 39

Engineering Mathematics Course Descriptions for Agricultural & Bio-Resources Engineering and Technology-Based Disciplines

COURSE DESCRIPTIONS

300 Level

Engineering Mathematics **6 Credits**

1. Linear Algebra – Elements of Matrices, determinants, Inverse of matrix. Theory of linear equations, Eigen-Values and Eigen Vectors.
2. Analytic geometry – Co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates.
3. Elements of functions of several variables.
4. Numerical differentiation, solution of ordinary differential equations, Curve fitting, Simple linear programming.
5. Fourier series – Euler coefficients, even and odd functions, sine and cosine functions, simple applications. Gama, Beta and probability functions.
6. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties.
7. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient Line, surface and volume integrals and related theorems.

400 Level

Engineering Mathematics **3 Credits**

1. Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems:
2. Laplace and Fourier transform - Applications
3. Introduction to non-linear differential equations – stability and Applications.
4. Probability – Elements of probability, density and distribtion functions, moments, standard distribution, etc.
5. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

Agricultural And Bio-Resources Engineering Course Descriptions

(i) **Basic Agric. & Bio-Resources Engineering** **2 Credits**

Introduction to Agricultural & Bio-Resources engineering profession. Agricultural and Bio-Resources. Identification of various tractors. Identification of other farm power sources. Types of farm implements. Tractor driving and test. Use of tractor for various field operations.

(ii) **Land Surveying** **3 Credits**

Definitions. Measurement of distances. Use of minor instruments, Random errors. Chain surveying. Bearing of lines. Levelling. Topographic surveys. Traversing. Theodolite traversing. Plane table surveying. Triangulation. Land shaping and earthwork.

(iii) **Hydrology** **3 Credits**

Hydrologic cycle. Solar and earth radiation. Precipitation. Evapotranspiration, Infiltration. Rainfall-runoff over agricultural land. Stream gauging. Hydrographs. Streamflow routing. Groundwater hydraulics. Watershed management. Flood control.

(iv) **Geology for Engineers** **2 Credits**

The earth. Geological processes. Engineering properties of rocks. Stratigraphy. Geotechnics. Geomorphology. Mineralogy and Petrology. Geology of Nigeria.

(v) **Machine Drawing and Design** **2 Credits**
Part assembly. Detailed drawing of machine components.
Sketching and use of standards: design features, symbols, screws, fasteners, couplings, clutches, gears. Machine component design. Presentation of design portfolio.

(vi) **Hydraulics** **2 Credits**
Fluid properties. Fluid statics. Fluid motion: continuity, Bernoulli, energy, momentum equations. Reynolds number. Laminar and turbulent flows. Pipe flow. Open channel flow. Weirs, flumes, pumps, turbines, outlets, gates, valves.

(vii) **Metallurgy** **2 Credits**
Metals and alloys, their production and use. Nature, origin and control of structure in metallic systems and their relation to mechanical properties. Diffusion, deformation, hardening, transformation. Heat treatment. Metallographic laboratory practice.

(viii) **Mechanics of Machines** **2 Credits**
Force and motion relationships in constrained mechanisms. Analysis of car, gear, linkage, belt drive and chain drive systems for motion and power transmission. Vehicular mechanics: brake and clutch systems. Kinetics of rotating and reciprocating masses. Elements of vibratory systems.

(ix) **Soil Science** **2 Credits**
Origin and formation of soils. Physical properties of soils. Soil colloids; soil reaction; soil mineralogy. Soil organic matter. Soil survey and classification. Water movement in soils.

(x) **Soil Mechanics** **2 Credits**
Phase relationships, shear strength, consolidation, settlement, compaction. Machinery-soil-relationships, site investigations.

(xi) **Animal Production** **3 Credits**
Types of livestock (for eggs, milk, meat, wool, etc)
Distribution of livestock in Nigeria. Animal feeding and nutrition. Forage crops and their preservation. Artificial insemination. Livestock housing. Livestock processing equipment.

(xii) **Crop Production** **3 Credits**
Classification and ecology of crops in Nigeria. Nutrient requirements and mineral nutrition of plants. Manures and fertilizers. Plant growth and development. Growth stages. Tillage and weed control. Other cultural practice. Cropping sequences and rotation. Farming systems. Production practices for specified crops.

(xiii) **Technical Communication** **2 Credits**
Principles of effective communication. Professional use of the English language. Principles of technical writing. Oral presentation of technical ideas.

(xiv) **Farm Power and Machinery** **3 Credits**
Farm power sources. Selection and management of farm tractors and equipment. Force analysis and power measurement on tillage tools. Field performance evaluation of crop production equipment. Adjustment, maintenance, and repair of farm tractors and equipment.

(xv) **Irrigation and Drainage** **3 Credits**
Water requirements in an irrigation system. Methods of irrigation. Frequency and amount of irrigation. Irrigation water scheduling. Evaluating irrigation systems and practices. Design of furrow, basin and sprinkler irrigation. Effect of poor drainage on plants and soils. Drainage requirements of crops, surface drainage. Sub-surface

drainage.

(xvi) **Farm Structures and Environmental Control 3 Credits**
Environmental and structural requirements of crops and livestock, Planning of plant and livestock houses, storage and stores. Design of structural members. Water supply and sewage disposal. Specifications and selection of farm building materials. Environmental control for plants and livestock. Use of psychrometric charts. Farmstead planning and layout.

(xvii) **Properties, Handling, Processing and Storage of Agric. Materials 3 Credits**
Properties and characteristics of agric. Materials. Cleaning, sorting and grading. Handling methods. Processing techniques. Crop drying. Crop storage.

(xviii) **Farm Management, Rural Sociology and Agric. Extension 2 Credits**
Application of basic sociological concepts to rural life. Management decision making. Functions of Management planning, organisation, staffing, directing and controlling. Financial management. Principles of Extension: diffusion, adoption and rejection of innovations. Communication and leadership in agricultural extension.

(xix) **Economics 2 Credits**
Basic concepts. Factors of production. Supply and demand. Price, Elasticity analysis. Household behaviour theories, Business organisation, Production, the market. Income, Employment – classical, non-classical and keynessian approaches. Money, Expenditure, Taxation, Budget, International trade.

(xx) **Principles of Management 3 Credits**
Principles of Management. Industrial group and organisational behaviour. Motivation, Industrial Law, legislation on wages, trade marks and patents. Law of contract and sale of goods. Liability for industrial injuries. Industrial relations. Trade unions, employer associations, wage bargaining and the role of the state.

(xxi) **Farm Electrification 3 Credits**
Electrical codes, tariffs and regulations. Generation and transmission of electricity, Farmstead distribution systems. Testing procedure. Power factor correction. Selection and use of electric motors. Transformers. Energy conversion. Application of electricity to handling, processing and storage of agricultural products. Basic electronic applications to farm electrical processes.

(xxii) **Soil and Water Conservation 3 Credits**
Types of erosion, Soil erosion by water, Universal soil loss equation. Control of soil erosion by water. Wind erosion and its control, Desertification and control measures. Earth dams and farm ponds.

(xxiii) **Land Clearing and Development 2 Credits**
Land resources and Land Use Act in relation to Nigerian agriculture. Objectives, methods and equipment for land clearing and development. Machinery selection, mechanics of operation and vegetation types. Land reclamation. Earthmoving machinery and earthmoving mechanics.

(xxiv) **Agricultural Mechanisation 2 Credits**
Nature and objectives of agricultural mechanisation. Factors affecting agricultural mechanisation in the tropics. Analysis of production systems. Agricultural mechanisation as a strategy for rural development. Impact on food production and on infrastructural development. Linkages with rural industrialisation. Case studies of selected farms.

(xxv) **Final Year Project** **6 Credits**
Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

(xxvi) **Agricultural Power** **3 Credits**
Farm power sources. Farm tractor; selection, use, maintenance. Other power sources; selection, use, maintenance. Hitches and hitch systems, design considerations of single-axle, two-wheel drive, four-wheel drive and crawler tractors. Tractor mechanics. Power Measurement. Fluid controls. Ergonomics. Tractor testing and test codes.

(xxvii) **Agricultural Machinery** **3 Credits**
Force analysis and design consideration of various farm machinery. Hitching methods. Power requirement for operating farm equipment and machines. Operation and maintenance of various farm machinery. Field evaluation. Criteria for replacement. Cost analysis of the use of agricultural machines.

(xxviii) **Mechanics of Deformable Bodies** **2 Credits**
Three dimensional stress and strain. Theories of failure. Stress concentration. Moments and products of inertia and area. Mohr's strain and inertia circles. Unsymmetrical bending, shear center. Curved beams.

(xxix) **Design of Agricultural Machines** **2 Credits**
Machine design processes and procedures. Materials of construction: selection, strength properties, stress analysis, costing. Design of machine elements. Machine fabrication. Typical designs of low cost agricultural machinery. Problems and prospects of agricultural machinery development and commercial manufacture in Nigeria.

(xxx) **Operation and Management of Farm Power and Machinery Systems** **2 Credits**
Integrated approach to machinery usage and agricultural production sequence. Equipment selection, scheduling of operation, seasonality factor. Machinery management. Machinery ownership and financing. Gross margin analysis. Optimisation of machinery – input combinations. Management of farm enterprise. Case studies.

(xxxi) **Irrigation** **3 Credits**
Design of open channels. Water flow measurement. Pumping power requirements. Design of irrigation systems: border, sprinkler, drip, etc. Salinity and quality of irrigation water. Reclamation of saline and alkali soils. Seepage from canals and canal lining. Design of an irrigation project. Evaluating irrigation systems and practices. Irrigation water management.

(xxxii) **Agricultural Land Drainage** **2 Credits**
Surface drainage. Subsurface drainage. Design of drainage systems. Envelope materials and their design. Loads on conduits. Drainage pumping. Construction and installation of drains. Maintenance of drains.

(xxxiii) **Advanced Hydraulics** **3 Credits**
Pipe flow, Pipes in parallel and in series. Branched pipes. Simple pipe network. Water hammer. Hardy Cross method of water distribution. Open channel flow. Channel transition and control. Hydraulic jump. Backwater curves. Dimensional analysis and similitude. Reservoir hydraulics and planning. High pressure outlets, gates, valves.

(xxxiv) **Rural Water Supply and Sanitation** **2 Credits**
Water requirements. Water quality standards. Water borne diseases. Biochemical oxygen demand. Potable water impurities. Sources and treatment methods of water for rural homes. Water lifting devices. Transportation and distribution systems. Pipe sizes.

Waste disposal in rural communities. Collection, conveyance, treatment and disposal of sewage from rural homes. Septic tanks, digestion ponds and family privies.

(xxxv) **Design of Irrigation and Soil Conservation Structures 2 Credits**
Factors affecting efficient farm water management. Review of relevant hydraulic theories. Design of irrigation structures. Design of soil conservation structures.

(xxxvi)**Environmental Engineering 3 Credits**
Design of unit operations and processes in water and wastewater treatment. Sedimentation. Chemical coagulation. Ion exchange. Filtration. Disinfection. Water supply treatment and distribution. Water quality. Wastewater handling, treatment and disposal. Solid waste disposal. Air pollution and control.

(xxxvii) **Foundation Engineering 3 Credits**
Stress in soils. Consolidation, compaction, CBR and soil improvement, stability of slopes. Earth pressure analysis. Bearing capacity and settlement analysis of shallow and deep foundations. Design of footings, foundations, retaining walls. Analysis and control of groundwater.

(xxxviii) **Advanced Thermodynamics 3 Credits**
Thermodynamics of gases, vapours and reactive and non-reactive mixtures. Process relations. Concepts of equilibrium, reversibility.

(xxxix)**Engineering Properties and Handling of Agricultural Materials 3 Credits**
Physical, mechanical, rheological and thermal properties of agricultural materials. Newtonian and Non-Newtonian fluids. Handling methods. Design and construction of appropriate material handling equipment for tropical products. Economics of material handling.

(xl) **Processing and Storage of Agricultural Products 3 Credits**
Cleaning, sorting, grading and separation: Principles, techniques and machine, communication, Particle size analysis. Heat treatment. Dehydration and drying. Psychrometry, Storage types and environment. Deterioration of produce in storage. Containerisation. Design of grain storage structures. Environmental control in storage.

(xli) **Solar Energy Applications to Processing and Storage 2 Credits**
Fundamentals of solar radiation. Solar heating and cooling, Heat transfer, solar energy conversion efficiency. Principles of solar collectors. Solar heat storage and storage systems for tropical crops.

(xlii) **Food Engineering 2 Credits**
Definition, Heat and mass transfer, Insulation, Heat exchangers-design and applications. Heat and cold preservation of foods. Food packaging, Food quality control. Principles and design of food equipment.

(xliii) **Farm Transportation 2 Credits**
Farm roads. Farm transportation system. Development and construction of farm transport equipment. Farm transport system - standards and specifications. Ergonomics.

(xliv) **Automotive Service and Maintenance 2 Credits**
Service and maintenance of all the components of an automobile.

(xlv) **Industrial Studies 2 Credits**
Organisational structure of manufacturing organisation. Market survey, Feasibility studies, Project and contract documents. Specification, Planning schedule, Quality control. Safety and safety procedures.

B. ENG. TELECOMMUNICATIONS ENGINEERING

		Lecture/Lab. Units
(a)	**Course Summary**	
(i)	**Humanities**	
	General Studies	16
(ii)	**Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
	Total	46
(iii)	**Entrepreneurial Studies**	4
(iv)	**Basic Engineering Courses**	
	Engineering Mathematics	6
	Computers & Computing	4
	Engineering Drawing	4
	Applied Mechanics	4
	Strength of Materials	2
	Material Science	3
	Thermodynamics	2
	Fluid Mechanics	2
	Basic Electrical Engineering	6
	Manufacturing Technology/Workshop	2
	Engineer-in-Society	1
	Total	**36**
(v)	**Core Courses**	
	Engineering Mathematics	12
	Physical Electronics	2
	Analogue Electronic Circuits	3
	Digital Electronic Circuits	3
	Measurements and Instrumentation	3
	Circuit Theory	6
	Digital Devices and Logic Circuits	3
	Control Theory	3
	Communications Principles	3
	Electrical Machines	2
	Electrical Power Systems	2
	Computer Programming	2
	Assembly Language Programming	2
	Numerical Computer Technology	3
	Laboratory Practicals	9
	Advanced Circuit Design	3
	Solid State Electronics	3
	Communication Theory	3
	Telecommunications Engineering	2
	Digital Communication System	3
	Optical Communication System	2
	Image and Data Transmission System	2
	Industrial Electronics Design	2
	Digital Signal Processing	2
	Feedback and Control Systems	2
	Communication System Planning	2

Project	4
Electives	6
Total	**98**

Break-Down Of Courses Into Levels Of Study
Core Courses

300 Level

Course Title	
Engineering Mathematics	4
Physical Electronics	3
Circuit Theory	3
Analogue Electronics Circuits	3
Digital Electronics Circuits	3
Measurements and Instrumentation	3
Electrical Machines	2
Electric Power Systems	2
Computers & Computing	2
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**35**

400 Level

Course Title	
Engineering Mathematics	2
Digital Devices and Logic Circuits	3
Control Theory	3
Communications Principles	3
Assembly Language Programming	3
Digital Computer Technology	3
Laboratory Practicals	3
Sub-Total	**20**

500 Level

Course Title	
Advanced Circuit Design	3
Solid State Electronics	3
Communication Theory	3
Telecommunications Engineering	2
Digital Communication System	3
Optical Communication System	2
Image and Data Transmission System	2
Industrial Electronics Design	2
Digital Signal Processing	2
Feedback and Control Systems	2
Communication Systems Planning	2
Project	4
Electives	6
Total	36

COURSE DESCRIPTIONS

Core Courses 300 Level, 400 Level And 500 Level

(i) **Engineering Mathematics**
Calculus of several variables: limits and continuity. Partial derivatives of first and higher orders. Total differential of a function Jacobians. Higher order partial and total derivatives and gradient of a function. Integration of total differentials with application to mechanics. Introduction to vector fields - divergence and curl. Generalised Taylor's series; the calculus of variations. Lines integral with application on computation of areas and volumes. Functions of complex variables. Cauchy-Riemann Equations. Analytical functions. Mapping by elementary functions.

(ii) **Physical Electronics**
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(iii) **Analogue Electronics Circuits**
Review of single-stage transistor amplifiers using BJTS and EETs Equivalent circuit and calculation of current gain, voltage gain, power gain, in put and out put impedance. Operational Amplifiers: Parameters and applications. Feedback, Broadband and narrowed band amplifies. Power amplifiers. Voltage and current stabilizing circuit. Voltage amplifiers, multi storage amplifier. Using BJTs and FETs.

(iv) **Digital Electronics Circuits**

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean Algebra. Simplification of Logic expressions using Karnaugh Method. Design combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counters, registers and timers. Switching and Waves shipping circuit. Generation of non sinusoidal signal (multi vibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc)

(v) **Measurements And Instrumentation**
General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impendance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital volumeters; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generators, function generators, wave analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(vi) **Circuit Theory**
Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

(vii) **Digital Devices And Logic Circuits**
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and software. Basic image processing concepts.

(viii) **Control Theory**
Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(ix) **Communications Principles**
Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(x) **Electrical Machines**
Review of electromechanical energy conversion, rotating magnetic fields, performance and methods of speed control of DC machines, induction motors, linear induction motors, circle diagrams, power transformers, parallel operation of 3-phase transformers.

Performance of synchronous machines, parallel operation of synchronous generators, fractional horse-power motors, single-phase induction motors, universal motors. Reluctance motors, hysteresis motors. Faults on machines, methods of starting and protection of machines.

(xi) **Electrical Power Systems**
Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

(xii) **Computer Programming**
Computer programming using structure BASIC such as QBASIC: symbols, keywords, identifiers, datatypes, operators, statements, flow of control, arrays, and functions. Extensive examples and exercises in solving engineering problems using QBASIC. Use of Visual programming such as Visual BASIC in solving engineering problems.

(xiii) **Assembly Language Programming**
Introduction: Language level of abstraction and effect on machine, characteristics of machine code, advantages , justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: Programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, program control, machine control, input/output , etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service

routine. Interfacing of assembly language to C . Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

(xiv) **Numerical Computer Technology**
Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored program concept. Von-Neuman architecture. Havard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types), Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor. Control Unit: Micro-operations, control of the CPU, hardwired implementation, control unit operation, micro-instruction sequencing and execution, micro-programmed control. Use INTEL family, and MOTOROLA family as case study of a CISC computer system. Instruction Set and Register: Machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organization, instruction pipelining. High performance computer systems: Techniques to achieve high performance, pipelining, storage hierarchy, units with function dedicated for I/O. RISC, introduction to superscalar processor, parallel processor. Use popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating System: Overview of operating system, dimension and type of operating system, high level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory, UNIX/LINUX operating system: architecture, commands, programming; window based operating systems (MS windows, X-window).

(xv) **Practicals**
Electrical Machines Laboratory:
A laboratory work on electrical machines designed to illustrate topics covered in Electromechanical Devices and Machines.

Telecommunication Laboratory
A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, turned circuits and active analogue filters.

Digital Electronics Laboratory
A laboratory work on digital electronics designed to illustrate topics covered in Electronic circuits.

Electronic Circuits Laboratory
A laboratory work on electronic circuits designed to illustrate topics covered in Electronic Circuits.

Core Courses 500 Level: (2 Semesters)

(i) **Advanced Circuit Design**
Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops, Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate

packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(ii) **Solid State Electronics**
Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and eptitaxical material growth and impurity control, metal-semi-conductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

(iii) **Telecommunication Theory**
Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(iv) **Telecommunications Engineering**
Cable telegraphy and telephony characteristics, cross talk, equation, Poleliness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

(v) **Digital Communication System**
Block Diagram of digital communication system sampling theorem, Shannm theorem and applications in digital communication system. Advantages of digital signals . Noise in digital system. Filtering and equalisation. Digital modulation techniques: FSK, ASK, QPSK, M-PSK, QAM, etc. Error detection and correction techniques. Encoders/Decoders. Applications of digital communication system: Satellite communication, telephoning microwave, wireless communication, optical communication, Broadband. Communication. Internet Technology.

(vi) **Optical Communication System**
Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, couphing/deep space communication system/capacity, reliability economy/application of PCM and A DPCM concepts.

(vii) **Image And Data Transmission System**
A/D and D/A transformation, coding, error detection and correction, Asynchronous and synchronous transmission, modern schemes, channel capacity, equalisation techniques, practical modern applications, simplified network configurations, data switching.

(viii) **Industrial Electronics Design**
Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems. Fire alarms, burglar alarms and general home and industrial instrumentation.

(ix) **Digital Signal Processing**
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital

filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and software. Basic image processing concepts.

(x) **Feedback And Control Systems**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(xi) **Telecommunication Systems Planning**

FDT, Modulation Plan, High Order PCMCCITT Requirement Delta Modulation And ADPM, Different Type Systems Co-Operation Integrated Network, Network Planning.

(xii) **Project**

This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.