6. DEPARTMENT OF ELECTRICAL/ELECTRONICS ENGINEERING

(a) Curriculum for B.Sc. Degree in Electrical/Electronics Engineering

100 LEVEL HARMATTAN SEMESTER

Course Code	Course Title	Pre-requisite	Total Units	Status
MEE 101	Engineering Drawing I	-	2	C
CHM 101	General Chemistry I	-	3	C
CHM 107	Experimental Chemistry I	-	1	C
MTH 101	General Mathematics I (Algebra & Trigonometry)	-	3	C
PHY 101	General Physics I	-	3	C
PHY 107	Experimental Physics I	-	1	C
CIT 111	Introduction to Information & Communication Technology	-	2	R
GNS 101	Use of English 1	-	2	R
LIB 101	Use of Library	-	1	R
FRN 221	Basic French	-	2	R
	TOTAL		**20**	

100 LEVEL RAIN SEMESTER

Course Code	Course Title	Pre-requisite	Total Units	Status
MEE 102	Workshop Technology	-	2	C
CHM 102	General Chemistry II	-	3	C
CHM 108	Experimental Chemistry II	-	1	C
MTH 102	General Mathematics II (Calculus)	MTH101	3	C
MTH 104	General Mathematics III (Vectors, Geometry & Dynamics)	MTH101	3	C
PHY 102	General Physics II	-	3	C
PHY 108	Experimental Physics II	-	1	C
CIT 112	Introduction to Computer Programming	-	2	R
GNS 102	Use of English 2	-	2	R
FRN 222	French for Specific Purposes	-	2	R
	TOTAL		**22**	

200 LEVEL HARMATTAN SEMESTER

Course Code	Course Title	Pre-requisite	Total Units	Status
CVE 201	Engineer in Society	-	1	C
EEE 201	Applied Electricity I	-	2	C
EEE 291	Applied Electricity Laboratory	-	1	C
MEE 201	Engineering Materials	-	2	C
MEE 203	Engineering Mechanics I (Statics)	-	2	C
MEE 205	Basic Thermodynamics	-	2	C
MTH 201	Mathematical Methods I	MTH101, MTH102	2	C
STA 201	Statistics for Physical Science & Engineering	-	4	C
CIT 201	Structured Programming	CIT111	3	C
GNS 201	Nigerian Peoples and Culture	-	2	R
	TOTAL		**21**	

200 LEVEL RAIN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
CVE 202	Strength of Materials	-	2	C
EEE 202	Applied Electricity II	EEE 201	2	C
EEE 292	Applied Electricity Laboratory II		1	C
MEE 204	Engineering Mechanics II (Dynamics)	MEE 203	2	C
MEE 206	Basic Fluid Mechanics	-	2	C
MEE 208	Workshop Technology II	MEE 102	2	C
MTH 202	Elementary Differential Equation I	MTH102	2	C
MTH 206	Introduction to Numerical Analysis	MTH101, MTH102	3	C
CIT 202	Low Level Language	-	2	C
GNS 202	Osun Peoples and Culture	-	2	R
	TOTAL		**20**	

EEE 200: SWEP (Vacation Period) 8 weeks

300 LEVEL HARMATTAN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 301	Microelectronic Devices & Circuits I	EEE 201	3	C
EEE 303	Electromechanical Devices	EEE 202	3	C
EEE 305	Computational Structures I	EEE 201	3	C
EEE 307	Group Design I	-	1	C
EEE 309	Signals & Systems	EEE 201, EEE 202	3	C
EEE 311	Electromagnetic Theory	EEE 202	3	C
EEE 391	Electrotechnics Laboratory	-	1	C
MTH 303	Elementary Differential Equation II	MTH201	3	C
GNS 301	Entrepreneurship Skills Development and Practice	-	2	R
	TOTAL		**22**	

300 LEVEL RAIN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 302	Microelectronic Devices & Circuits II	-	3	C
EEE 304	Elecrical Machines	EEE 303	3	C
EEE 306	Computational Structures II	EEE 305	3	C
EEE 308	Digital Circuit Analysis & Design	EEE 305	3	C
EEE 310	Measurement & Instrumentation	EE 201, EEE202	3	C
EEE 392	Electrical Machine Laboratory	-	2	C
MTH 302	Mathematical Methods II	MTH201	2	C
GNS 302	Introduction to Logic and Philosophy	-	2	R
	TOTAL		**21**	

EEE 300: Student Work Experience Programme (Vacation Period) 8 weeks

400 LEVEL HARMATTAN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 401	Electric Power Principles	EEE 303	3	C
EEE 403	Group Design II	-	1	C
EEE 405	Analog Circuit Design	EE 302	3	C
EEE 407	Introduction to Control Engineering	EEE 309	3	C
EEE 409	Communication Principles	EEE 309	3	C
EEE 411	Semiconductor Devices	EEE 302	3	C
EEE 491	Telecommunication & Control Laboratory	-	4	C
CVE 401	Technical Report Writing	-	2	C
	TOTAL		**22**	

400 LEVEL RAIN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 400	SIWES		6	C
	Total		**6**	

500 LEVEL HARMATTAN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 501	Students Project	-	3	C
EEE 503	Control System Engineering i	EEE 407	3	C
EEE 505	Probability & Stochastic Processes	STA 201	3	C
EEE 507	Advanced Circuit Techniques	EEE 302	3	C
CVE 511	Industrial Economics	-	2	C
CVE 513	Industrial Law & Management	-	2	C
	TOTAL		**16**	

Electives: Not less than 3 units from the following:

Communications Option				
EEE 511	Radio Frequency Electronics	EEE 409	3	E
EEE 513	Wireless Communication	EEE 409	3	E
Instrumentation & Control Option				
EEE 521	Introduction to Modern Control	EEE 407	3	E
EEE 523	Instrumentation Engineering	EEE 310	3	E
Power & Machine Option				
EEE 531	Power Electronic Devices & Circuits	EEE 302	3	E
EEE 535	Power System Engineering I	EEE 401	3	E

500 LEVEL RAIN SEMESTER

Course Code	Course Title	Pre-Requisite	Units	Status
EEE 502	Students Project	-	3	C
EEE 504	Digital Signal Processing	EEE 309	3	C
EEE 506	Electrical Services & Energy Utilization	EEE 401	3	C
EEE 508	Application of Electromagnetic Principles	EEE 311	3	C
EEE 510	Reliability Engineering	-	2	C
EEE 512	Advanced Computer Programming & Statistics	-	3	C
	TOTAL		**17**	

Electives: Not less than 3 units from the following:

Communications Option				
EEE 514	Telecommunications Engineering	EEE 513	3	E
EEE 516	Computer Communication	EEE 513	3	E
EEE 518	Communications Theory	EEE 409	3	E
Instrumentation & Control Option				
EEE 522	Control System Engineering II	EEE 503	3	E
EEE 524	Modeling & Simulation of Dynamic Systems	EEE 521	3	E
EEE 526	Introduction to Heuristic Methods in Control	EEE 521	3	E
Power & Machine Option				
EEE 532	High Voltage Engineering	EEE 401	3	E
EEE 536	Power System Engineering II	EEE 535	3	E

COURSE DESCRIPTION (B.Sc. Mathematics)

MEE 101: ENGINEERING DRAWING I (2 UNITS)

Instruments for engineering drawing and their uses. Drawing paper sizes, margins and title blocks. Lettering and types of line, Geometrical instruction bisection of lines and angels and their applications. Polygon, tergency, locus of simple mechanism. Pictorial drawing, isometric, oblique and perspectives. Orthographic

projection. Dimensioning and development of simple shape. Assembly drawing of simple component.

MEE 102: WORKSHOP PRACTICE I (2 UNITS)

General Introduction of facilities in engineering workshops and safety in workshops, Measuring instruments, calipers, micrometers, gauges etc. manual and machine-operated workshop tools for metals and wood work and their care.

Benchwork; metal and woodwork practice. Machines for turning, milling, shaping, drilling etc. Introduction to Welding. General Introduction in automobile workshop practices. Identification of automobile parts and their functions.

MTH 101 GENERAL MATHEMATICS I (Algebra and Trigonometry)

(3 UNITS) (L30 HRS, PO:T15HRS)

Elementary set theory, subsets, union, intersection, complements and Venn diagrams. Real numbers: integers, rational and irrational numbers, real sequences and series, Mathematical induction, theory of quadratic equations. Matrices. Binomial theorem. Complex numbers: Algebra of complex numbers; the Argand Diagram, De Moivre's theorem, n^{th} roots of unity. Circular measure, Trigonometric functions of angles any magnitude, addition and factor formulae.

MTH 102 GENERAL MATHEMATICS II (Calculus) (3 UNITS) (L30, PO: T15) Pre-requisite: MTH 101

Functions of a real variable, graphs, limits and idea of continuity. The derivate as limit of rate of change. Techniques of differentiation. Extrema and curve sketching: Integration as an inverse of differentiation. Methods of integration. Definite integrals. Application to areas and volumes.

MTH 104 GENERAL MATHEMATICS III (Vectors, Geometry and Dynamics) (3 UNITS) (L30HRS: PO: T15HRS) Pre-requisite: MTH 101

Geometric representative 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 line, circle, parabola, ellipse, hyperbola, tangent normal. Kinematics of Particles. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles, resisted vertical motion, elastic strings, simple pendulum, impulse. Impact of two smooth spheres, and of a sphere on a smooth sphere.

CVE 200 STUDENTS WORK EXPERIENCE PROGRAMME I (2 UNITS)

A practical work programme, during the long vacation, arranged within the campus and its immediate environment to enable the students gain some basic skills in the

profession of engineering in general and student's chosen field of engineering in particular.

CVE 201: INTRODUCTION TO ENGINEERING AND TECHNOLOGY (1 UNIT)

Philosophy of science. History of Engineering and Technology. Divisioning of Engineering. Safety in Engineering. Introduction to risk analysis. The role of engineers in nation building.

CVE 202: STRENGTH OF MATERIALS (2 UNITS)

Force equilibrium free body diagrams**.** Elasticity – concept of stress strain,

Tensile test, young's modules and other strength factors. Axially loaded bars. Temperature stresses and simple indeterminate problems. Stresses in cylinders and rings. Bending moment, shear force and axial force. Diagrams for simple cases. Simple trusses and deflection of beams torsion.

CVE 204: ??????????????????????

EEE 201: BASIC ELECTRICAL ENGINEERING 1 (2 UNITS)

Fundamental theory of electric circuit. Circuit elements. Network theorems supper position, Theveinin, Norton). Nodal and loop analysis of circuits (Kirchoff's laws) single time-constant circuits. Steady state response of circuit elements and network. Complex impedance and admittance. AC circuit impedance, admittance, susceptance phasor diagrams. Introduction to electronics, vacuum diode, triode and pentode, small signal equivalent circuits. Elementary discussion of semiconductors P. N junction diode transistors.

EEE 207: BASIC ELECTRICAL ENGINEERING PRACTICALS (1 UNIT)

Laboratory experiments to demonstrate the application of the theory covered in the courses.

MEE 201: ENGINEERING MATERIALS (2 UNITS)

Physical properties of materials; atomic and molecular structure, bonding forces, structure of materials, wood, cement, plastics, metallic states. Crystals and defects crystal, isotrophy and anisotrophy; essential and desirable properties of engineering materials; physical mechanical, thermal, chemical, technology and electrical properties. Common engineering materials for structures, machine parts/equipment, electrical items, instruments. Factors to be considered in the selection and choice of engineering materials.

MEE 208: WORKSHOP TECHNOLOGY II (2 UNITS)

Introduction to automobiles; main components of automobiles. Fundamentals of engine operation and construction; basic concepts and definitions, engine cycles, principles of operation of valve mechanism, cooling, lubrication, fuel and starting

system, etc maintenance and general servicing of automobiles; daily routine preventive maintenance, etc. Fault training, trouble shooting and remedies for ignition fuel, brake systems etc. Fabrication and machining of components from available drawings. Welding and fabrication, fundamentals of welding, welding processes, welding joint preparation, welding inspection etc.

MEE 203: ENGINEERING MECHANICS I (STATICS) (2 UNITS)

Statics law of statics, system forces and their properties. Simple problems. Centre of mass, moment of Enertia, analysis of coplanar forces, friction. Work and energy. Vectors centre of gravity and centre of mass.

MEE 204: ENGINEERING MECHANICS II (DYNAMICS) - (2 UNITS)

Newton's laws of motion and their application. Impulse and momentum kinetic energy. Kinematics of a point, composition and resolution of velocities and accelerations, relative velocities and acceleration, representation of vectors. Plane kinematics of a rigid body, angular velocity diagrams applied to simple mechanisms. Instantaneous centre of rotation. Equation of motion, linear momentum and moment of momentum. Kinetic energy, moment of inertia.free vibrations of systems with one or two degrees of freedom including damping. Tortional vibration – SWEP

MEE 205: BASIC THERMODYNAMICS (2 UNITS)

Definition of basic thermodynamics terminologies system, state, properties and processes. Energy and energy conversion; work, heat, non-flow processes. Zeroth law. First law of thermodynamics and application o closed and open systems. The steady flow energy equation and its applications. Second law of Thermodynamics; Consequences and applications of second law. Thermodynamics properties of ideal and real fluids. thermodynamics tables Introduction to steam power and refrigeration cycles.

MEE 206: BASIC FLUID MECHANICS (2 UNITS)

Element of fluid statics; density, pressure, surface tension, viscocity, compressibility e.t.c. Hydrostatic forces on submerged surfaces due to incompressible fluid. Introduction to fluid dynamics – conversion laws. Introduction to viscious flow. Dynamics of fluid flow – conservation. Equation of mass and momentum. Euler and Bernonlli's equations. Reynolds number Dimensional analysis, similitude, Buckingham P,. Theorems. Application of hydraulic models. Flow meters and error in measurement.

MTH 201 MATHEMATICAL METHODS I (2 UNITS) (C) (L15HRS: P0: T15HRS) Pre-requisite - MTH101, MTH102

Real-value functions. Review of Differentiation and integration and their applications. Mean value theorem, Taylor series. Real-value functions of two or three variables. Partial derivatives, chain rule, Lagrange multipliers, extrema (maxima and minima),

language multipliers. Increments, differential and linear approximations. Evaluation of line integrals. Multiple integrals.

MTH 202 ELEMENTARY DIFFERENTIAL EQUATIONS I (2 UNITS) (L15HRS: P 0: T15HRS) Pre-requisite - MTH102

Derivation of differential equations from primitive, geometry, physics and so on. Order and degree of differential equation. Techniques of solving first and second order linear and non linear differential equations (Laplace transform included). Solutions of system of first order linear equations. Finite linear equations. Solutions of system of first order linear equations. Finite linear difference equations. Application to geometry and physics.

MTH 206 INTRODUCTION TO NUMERICAL ANALYSIS (3 UNITS) (L30HRS: P 0: T15HR) Pre-requisites - MTH101, MTH102

Solution of algebraic and transcendental equations. Curve fitting. Error analysis. Interpretation and approximation. Zeros of non-linear equations in one variable. Systems of linear equations Numerical differentiation and integral equations. Initial value problems for ordinary differential equations.

STA 201: STATISTICS FOR PHYSICAL SCIENCES AND ENGINEERING (4 UNITS)

Probability- elements of probability, density and distribution functions, moments, standard distribution, etc.statistics- Regression and correlation- Large sampling theory. Test hypothesis and quality control.

EEE 201 APPLIED ELECTRICITY I 2-1-0 (3 Units)
Ideal Sources and Passive Components
Linear Resistive Networks
Network theorems – Kirchoff's voltage law (KVL), Kirchoff's current law (KCL), Norton, Thevenin and Superposition theorems
Non-linear Resistive Networks
Digital Abstraction
Digital Representation and Processing
Energy Storage
Elementary Discussion of Solid State Devices ***Prerequisite: PHY102***

EEE 202 APPLIED ELECTRICITY II 2-1-0(3 Units)
Magnetic field of currents in space
Time-varying Signals
Step Response of RC, RL and RLC Circuits
Impulse Response of RC, RL and RLC Circuits
Single-Phase Alternating Current circuits- complex impedance and admittance, resonant circuits
Sinusoidal Steady State Response of RC, RL and RLC Circuits
Magnetic Circuits, mutual inductances, transformers. Introduction to electrical generators and motors.
Introduction to measuring instruments. ***Prerequisite: EEE201***

EEE 291: APPLIED ELECTRICITY LABORATORY I 0-0-3 (1 Unit)
Laboratory experiments to demonstrate the application of the theory covered in EEE 201.

EEE 292: APPLIED ELECTRICITY LABORATORY II **0-0-3(1 Unit)**

Laboratory experiments to demonstrate the application of the theory covered in EEE 202.

EEE 301: MICROELECTRONICS DEVICES & CIRCUITS I **2-1-0 (3 Units)**

Elementary Physical Electronics
Semiconductor Fundamentals
Charge Conduction Mechanisms
P-N Junction Electrostatics
MOS Electrostatics
MOSFET
Digital Abstraction
Simple Digital Circuits
CMOS Inverter
Other Logic Gates and
Other Digital Circuits ***Pre-requisites EEE 201***

EEE 302: MICROELECTRONICS DEVICES & CIRCUITS II **2-1-0 (3 Units)**

PN Junction Diode
Bipolar Junction Transistor
Single Stage Amplifiers
Frequency Response of Single Stage Amplifiers
Methods of Analysis
Frequency Response of Multi-stage Transistor Amplifiers
Differential Amplifiers, Other Amplifiers ***Pre-requisites EEE 301***

EEE 303: ELECTROMECHANICAL DEVICES **2-1-0 (3 Units)**

Introduction:

Magnetic Circuits, Magnetic Coupling, Mutual Inductance
Principles of Windings – Lap, Wave Windings

Transformers:

Coupled Circuits, Air cored transformers equivalent circuits, Iron cored transformers equivalent circuits, Referred impedance, no-load tests, short circuit tests and efficiency of single phase transformers. Three phase transformers. Group connection of windings, auto transformers, instrument transformers.

D.C. Machines

Armature winding, principles of commutation. Torque and emf expressions. Generator and motor configurations. Characteristics of series, shunt and compound wound motors. Speed control and electric braking, crossed field machines, commutator machines. ***Pre-requisites EEE202***

EEE 304: ELECTRICAL MACHINES **2-1-0 (3 Units)**

Synchronous Machines:

Synchronous machines theory. Equivalent circuit and phasor diagrams for cylindrical rotor. Effect of change in excitation, the V-characteristics with regards to transmission lines. Short circuit analysis of synchronous machine, d-, q-axis analysis of salient pole machines. Industrial applications of synchronous machines as generators and motors

Induction Machines

Magnetic flux, distribution of induced emf, equivalent circuit, power balance, equivalent circuit referred to stator. Torque-slip characteristics for generating and motoring actions. The circle diagram.

Losses, power flow, and efficiency of induction motors. Methods of starting and speed control. Double cage induction motor. Single phase motors. Industrial applications of induction machines.

Pre-requisites EEE 303

EEE 305: COMPUTATIONAL STRUCTURES I **2-1-0 (3 Units)**

Boolean algebra
Information representation
CMOS technology
Combinational Logic
Programmable/Reconfigurable Logic
Sequential Logic
Static D Latch
Clocked Sequential Circuits
Metastability and Arbitration
Control Structures
Fundamentals of Computing ***Pre-requisites EEE 201***

EEE 306: COMPUTATIONAL STRUCTURES II **2-1-0 (3 Units)**

Fundamentals of Computing
Programmable Architecture
Instruction Set Architecture
Machine Model
Machine Language Programming
Computer System Communication Issues
Memory Hierarchy
Operating System Issues ***Pre-requisites EEE 305***

EEE 307: GROUP DESIGN I **(1 Unit)**

Students will be divided into groups and assigned mini-design projects to carry out.

EEE 308: DIGITAL CIRCUIT ANALYSIS AND DESIGN **2-1-0 (3 Units)**

Review of device models
Digital building blocks
Storage elements and sequential circuits
Circuit techniques for array architectures
Interconnects
Energy consumption
Timing issues
Memory architecture ***Pre-requisites EEE 305***

EEE 309: SIGNALS AND SYSTEMS **2-1-0 (3 Units)**

Classification of Signals and Systems
Systems properties
Fourier series
Fourier transform
Sampling of ICT signals
Sinusoidal modulation
Laplace transforms applications
Feedback systems
z – transform ***Pre-requisites EEE 201 & EEE 202***

EEE 310: MEASUREMENT & INSTRUMENTATION **2-1-0 (3Units)**

Introduction to Signals and Measuring Systems
Modeling of Measuring Systems
Instrument for direct measurement of current and voltage
Measurement of resistance, inductance and capacitance, measurement of electrical energy, power, power factor and frequency. Principle of cathode-ray oscilloscope.
Transducers
Analog Signal Processing
Analog to Digital and Digital to Analogue Conversion
Design of measurement systems, transducers, instrumentation amplifier, differential amplifier circuits, sample-and-hold circuits, multipliers, linear and non-linear converters, Signal recovery. ADCs and DACs, Digital signals processing
Introduction to Biomedical-Electronics and medical instrumentation. ***Pre-requisites EEE 201 & 202***

EEE 311: ELECTROMAGNETIC THEORY **2-1-0 (3 Units)**

Review of Electrostatics
Review of Magnetostatic Fields
Ferromagnetic Materials
Boundary Value Problems
Time varying electromagnetic field
Maxwell's equations, their interpretation and physical significance
Waves: Solution of wave equations
Scattering of waves at boundaries ***Pre-requisites EEE 202***

EEE 391: ELECTROTECHINCS LABORATORY **(1 Unit)**

Laboratory experiments to demonstrate the application of the theory covered in the courses.

EEE 392: ELECTRICAL MACHINES LABORATORY **(2 Units)**

Laboratory experiments to demonstrate the application of the theory covered in the courses.

EEE 401: ELECTRIC POWER PRINCIPLES **2-1-0 (3 Units)**

Introduction to power systems
Properties of three-phase systems
Energy sources
Components of power generating systems
Transmission line and underground cables
Design and organization of power stations
Power system equipment: standards and safety ***Pre-requisites EEE 303***

EEE 403: GROUP DESIGN II **(1 Units)**

Students will be divided into groups and assigned mini-design projects to carry out.

EEE 405: ANALOG CIRCUIT DESIGN **2-1-0 (3 Units)**

Network synthesis: realizability of driving point impedance, Synthesis of two-terminal networks. Foster form realization, minimum phase and non-minimum phase networks. The approximation problem in network theory.

Passive filter design and synthesis. Spectral transforms and their application in the synthesis of high-pass and band-pass filters.
Op Amps as independent sources. The use of independent sources to change the poles and zeroes of transfer functions. Active network realization. ***Pre-requisites EEE 302***

EEE 407: INTRODUCTION TO CONTROL ENGINEERING **2-1-0 (3 Units)**

Control system concepts and components
Models of typical electrical, mechanical, thermal and fluid systems.
Block and signal flow diagrams.
Transfer functions of electrical and control systems
Frequency domain: Introduction to Transfer Functions
Time domain: General state space representation
Time response of systems
Reduction of multiple subsystems
System stability ***Pre-requisites EEE 309***

EEE 409: COMMUNICATION PRINCIPLES: **2-1-0 (3 Units)**

Basic concepts of communication system – Source, channel and user.
Baseband signals and systems analysis: Fourier series, Fourier transforms, impulse response, frequency response, distortion and group delay.
Amplitude Modulation and demodulation methods. Comparison of AM systems.
Angle modulation and demodulation; Wideband and narrowband FM
Sampling principles: theorems and techniques, quantization
Compounding, pulse modulation: PAM, PWM and PCM. Delta modulation, Adaptive delta modulation, differential PCM. Data transmission and reception: Binary ASK, FSK, and PSK: M-ary FSK and PSK, QAM.
Pre-requisites EEE 309

EEE 411: SEMICONDUCTOR DEVICES **3-0-0 (3 Units)**

Semiconductor fundamentals
Conduction mechanisms
Poisson and continuity equations
MOS Transistors
PN Junction Diode, Bipolar Junction Transistor
Microwave semiconductor devices
LED, LCD and other optical devices
Integrated circuits (IC): principles and fabrication of semiconductor devices.

Pre-requisites EEE 302

EEE 491: COMMUNICATION AND CONTROL LABORATORY (4 Units)
Pre-requisites EEE 392

EEE 501: FINAL YEAR PROJECT I **(3 Units)**

EEE 502: FINAL YEAR PROJECT II **(3 Units)**

EEE 503: CONTROL SYSTEMS ENGINEERING I **2-1-0 (3 Units)**

Linear control systems
Stability: Nyquist stability criterion, bode diagram approach, root locus and root contour method
Design of linear servo systems
State -space systems
Compensator design using the bode and root locus methods
Multiple loop feedback systems
Minimization of unwanted disturbance
Single and multi-term electronic controllers
Hydraulic and pneumatic controllers
Sensitivity of control systems ***Pre-requisites EEE 407***

EEE 504: DIGITAL SIGNAL PROCESSING 2-1-0 (3 Units)
Discrete-time systems and sampling
z-transforms
Discrete Fourier Transforms and Fast Fourier Transforms
Digital Processors
Digital Filters
Introduction to spectral analysis
Introduction to adaptive filtering
Introduction to signal compression ***Pre-requisites EEE 309***

EEE 505: PROBABILITY AND STOCHASTIC PROCESSES: 2-1-0 (3 Units)
Introduction to probability
Random variables
Multiple random variables
Functions of random variables
Moments and conditional statistics
Random processes
Correlation functions
Power density spectrum ***Pre-requisites STA 201***

EEE 506: ELECTRICAL SERVICES AND ENERGY UTILIZATION 2-1-0 (3 Units)
Design and organization of power supply: rated voltages and frequency. Types of power consumers and their characteristics, electrical installation in residential and industrial buildings.
Lighting systems and installation: Lighting control circuits. Electrical heating: heating of building, electrical furnaces, electrical welding, air conditioning and refrigeration. Electrochemical processes.
Motor control for industrial system: general and special factory drives.
Regulations on installation and operation of electrical equipment. Metering and tariff systems
Pre-requisites EEE 401

EEE 508: APPLICATION OF ELECTROMAGNETIC PRINCIPLES 2-1-0 (3 Units)
Review of transmission line theory. Wave equations. Common waveguides. Propagation in rectangular waveguides, attenuation in guides, guide terminations, Strip lines and Microstrip lines. Smith Chart.
Impedance matching and tuning: Lumped elements. Quarter-wave impedance transformer. Resonant cavities.
Radio wave propagation: Atmosphere and multipath effects, Signal fading and channel noise.
Antennas: dipole, Loop and monopole; radiation pattern and Antenna arrays.
Pre-requisites EEE 311

EEE 511: RADIO FREQUENCY ELECTRONICS 2-1-0 (3 Units)
Radio spectrum, ITU and spectrum management, Transmission lines and scattering parameters; Design of RF components (low noise amplifiers, power amplifiers, oscillators, RF power detector, active and passive mixers); Properties and representation of noise; passive device design (microstrip lines); active device design (bipolar and FETs). Parametric amplifiers, Microwaves solid state components; TWT, Klystrons and their applications
Pre-requisites EEE 409

EEE 513: WIRELESS COMMUNICATION **2-1-0(3 Units)**

Tropospheric propagation: Special features of VHF and UHF propagation. Propagation characteristics at microwave frequencies. Design of microwave links system. Effect of ionosphere on radio waves. Satellites communication systems, Multiple access methods in satellite communication. Earth stations for international communications. Mobile radio communications: simplex, half-simplex or full duplex, FDD, TDD cordless telephone system cellular systems: System design fundamentals.

Pre-requisites EEE 409

EEE 514: TELECOMMUNICATIONS ENGINEERING **2-1-0 (3 Units)**

Introduction to telephony, signaling. Principles of automatic telephone; strowger and cross bar exchanges, Electronic switching system. Tariff considerations. Telex and facsimile transmission, data transmission. Introduction to television Engineering, Black and white television broadcasting, colour television systems. Cable TV systems ***Pre-requisites EEE 513***

EEE 516: COMPUTER COMMUNICATIONS **2-1-0 (3 Units)**

Introduction to communication networks: point-to point and networked communications. Time, space and frequency division multiplexing, Packet switched networks. Multi access communication local area networks and wide area network services. Error control protocols, Synchronous data link control (SDLC). Routing algorithms, various Internet networking issues. Integrated Services Digital Networks: Narrowband and broadband ISDN, ATM, Traffic issues, wireless propagation channel, Cellular systems, Media access in wireless networks. Communication network simulation.

Pre-requisites EEE 513

EEE 518: COMMUNICATIONS THEORY **2-1-0 (3 Units)**

Review of probability for information theory, measure of information, entropy, Lossless source coding and data compression methodology using Huffman coding, Arithmetic coding and Lempel – Ziv algorithms, Material information; channel capacity. Different channel coding system. Error detection and correction codes using block and convolution codes. Random signals. Auto-correlation functions and power spectral densities. Optimal signal processing.

Pre-requisites EEE 409

EEE 521: INTRODUCTION TO MODERN CONTROL **2-1-0 (3 Units)**

State Space Modelling: Derivation of Models – Modeling with differential equations, Block diagrams, signals flow graphs.

The State Transition Matrix, derivation of the solution of state space systems, calculation of the state transition matrix, solutions using the state transition matrix. Transfer Function Analysis/Mason's Gain Formula Controllable, Observable, and Jordan Forms and other Canonical forms of Systems representations. Controllability, Observability, Stability, Asymptotic Stability, BIBO Stability, Liapunov stability analysis: 1^{st} and 2^{nd} method of Liapunov; stability analysis of linear and non-linear systems using the Liapunov method. Optimal control theory and application.

Pole Placement using State Feedback, Pole Placement using Output Feedback, State Observers/Reduced Order Observers. Application of calculus of variation, dynamic programming and Pontryagin's maximum principles; Time optimal control system, optimal systems based on the quadratic performance indices LQR/LQG. H_2 and H_{inf} system design, Introduction to Robust Control Design.

Minimum time problem, minimum fuel consumption problem, minimum energy problem. Liapunov second method and approach to solution of optimal control problems. Model reference control system. Introduction to Adaptive control system. ***Pre-requisites EEE 407***

EEE 522: CONTROL SYSTEMS ENGINEERING II 2-1-0 (3 Units)

Non-linear differential equations. Characteristics of non-linear systems; common non-linearities. Analysis of non-linear systems. Linearizing approximations, piecewise linear approximation, the describing function concept and derivation for common non-linearities, the dual input describing function; stability using the describing function. Limit cycle prediction. The phase- plane method for construction of phase trajectories, transient analysis by the phase method. Stability analysis of non-linear systems using Liapunov method. Introduction to sample data systems; The z-transforms; pulse transfer function and stability analysis in the z-plane.

Pre-requisites EEE 503

EEE 523: INSTRUMENTATION ENGINEERING 2-1-0 (3 Units)

Introduction to reliability, maintainability, availability and element reliability theory. Application to power system and electronic components. Climatic factors affecting reliability of electrical components and devices. Introduction to the design of electronics equipment. Specification including environmental factors such as vibration, humility and temperature. Tolerance and safety measures. Reliability and testing, Duplication of least reliable parts (standby), Ergonomics, aesthetics and economics. Miniature and micro miniature construction using printed circuit boards and integrated circuits. Maintainability. Computer based design methods. Virtual Instrumentation.

Pre-requisites EEE 310

EEE 524: MODELING AND SIMULATION OF DYNAMIC SYSTEMS: 2-1-0 (3 Units)

Introduction to concepts in modeling and simulation

Analog simulations:

Study of differential equations
Generation of time scaling
Simulation of control systems from block diagrams
Transfer functions and state equations
Analog memory and its applications
Repetitive and iterative operation of an analog computer

Digital Simulation:

Comparison of digital and analog/hybrid simulation
Modeling and Simulation software packages
Study of a few algorithms of interest in modeling and simulation: genetic algorithms,
Monte Carlo Techniques etc ***Pre-requisites EEE 521***

EEE 526: INTRODUCTION TO HEURISTIC METHODS IN CONTROL 2-1-0 (3 Units)

Review of Classical and Modern Control
Digital Control Systems
Hierarchical Control Architectures
Rule-based Systems
Adaptive Control and Self-learning Systems
Fuzzy Logic and its Application in Control
Neutral Network and Neural Control
Genetic Algorithms
Expert and planning Systems ***Pre-requisites EEE 521***

EEE 531: POWER ELECTRONIC DEVICES AND CIRCUITS 2-1-0 (3 Units)

Introduction to power semiconductor components: Power rectifier and circuits; half wave, full wave and three phase full wave rectifier circuit, controlled rectifier circuits; one phase one half wave, full wave three phase, half and full wave controlled rectifier circuits. Voltage-time area analysis; single phase and polyphase inverter circuits, harmonic analysis.

Chopper circuits: Types A and B. Four quadrant chopper circuits, A.C to A.C converters, A.C to D.C transmission links. Application of power semi-conductor circuits; regulated power supplies, uninterruptible power supplies, d-c and a-c drives. Induction heating and relays.

Pre-requisites EEE 302

EEE 532: HIGH VOLTAGE ENGINEERING 2-1-0 (3 Units)

Switching over-voltage; interruption of short circuits, interruption of capacitive and inductive circuits, current chopping. Arc extinction. Propagation of surges in H.V. transmission lines, lightning surges. Protection from direct lightning strokes. Earthing. Protection of transmission lines and substations from lightning. Corona and radio interference. Propagation of surges in transformers. Means of reducing overvoltages , insulation coordination.

Concept of breakdown in gases, vacuum, liquids and solids;

Insulation of overhead line and substation, busbars, and circuit breakers insulation. Insulation of transformers; generators, cable and condensers. Preventive testing of insulation, processes in a multi-layer dielectric, measurement of tan δ , capacitance, partial discharge voltage distribution, leakage resistance.

Pre-requisites EEE 401

EEE 535: POWER SYSTEM ENGINEERING I 2-1-0 (3 Units)

Overhead Transmission Lines:

Transmission line parameters (R, L and C) calculations. Equivalent circuits of transmission line, Underground types and parameters.

Modeling of Power Components

Transformers, transmission lines and synchronous machines;

System Modeling

Per unit calculations, network matrices

Power Flow Analysis

Gauss Siedel, Network-Raphson, and Fast decoupled methods

Control of voltage, real and reactive power in load flow problems

Faults in Power Systems:

Short-circuit analysis of synchronous machines. Synchronous and unsymmetrical fault analysis.

Pre-requisites EEE 401

EEE 536: POWER SYSTEMS ENGINEERING II: 2-1-0 (3 Units)

System Stability:

Transient stability swing equation, equal area criterion, multimachine stability, power system stabilizers.

Automatic Generation Control and Voltage Regulation:

Circuits breakers, relays, instrument transformers, protective schemes control circuits. Protection of transmission lines, transformers, generators and motors. Automatic reclosure and cut-in of standby supply.

Power System Planning:

Design considerations and load forecasting. Area Co-ordination and Pooling. Siting of new generation stations. Station management and maintenance routine.

Pre-requisites EEE 535