ECU 100: CHEMISTRY FOR ENGINEERS I

Structure of atoms: Model of atoms; the fundamental particles of the atom, Planck's quantification of energy and the photoelectric effect, ionization energy; nature of ionic and covalent compounds: Molecular shape chemical bonds, size and bond force: liquid and solid matters; structure of liquids; structure of solids; measurements and mole concept; properties of gases; law of gases: Chemical Reactions: Stoichiometry, thermochemical energy, heat and enthalpy, Periodic table: Main group elements I, main group elements II, d-Block transition elements: Organic chemistry: Simple organic functional group chemistry; alkanes, alkenes, alkynes, alky halides, alcohols, ketones, aldehydes, carboxylic acids and esters; chemistry of benzene, nuclear chemistry: Radioactivity, nuclear Energy.

ECU 101: PHYSICS FOR ENGINEERS I

Mechanics and properties of matter: mass centre, work, force, energy, impulse, momentum, vectors, rectilinear motion, Newton's Laws of motion and their applications: Composition and resolution of forces: Uniform circular motion: Newton's law of gravitation: Simple harmonic motion: Determination of gravity. Flow of liquids: Viscosity: Surface tension: Elasticity: elastic constants and their importance: Thermal physics: expansion of matter: Temperature scales: First law of thermodynamics; specific heat capacities of gases. Kinetic theory of gases: Mechanism of heat transfer, thermal conductivity, black body, Stephen's law: Sound: equation of wave motion and velocity of sound in matter.

ECU 109: FUNDAMENTALS OF COMPUTING

Introduction: History of computers: Computer and society: computer hardware and software: Understanding PC specifications, Computer performance and maintenance. Hardware components: CPU, Memory and I/O buses. Computer applications: exercise using word processing software and presentation graphics software; spreadsheets; Database (exercises in Access): Web Application (exercise in HTML): Machine level representation of data: Bits, bytes, and words; numeric data representation and number bases; representation of character data. Overview of operating systems: simple management: Introduction to net-centric computing: background and networking fundamentals. The Internet: use of networking software including e-mail, telnet, and FTP. Models of computation. Computers and information processing. General introduction to programming. Introduction to Algorithms and flow charts.

ECU 104: ENGINEERING MATHEMATICS I

The straight line: Equation of parallel and perpendicular lines; directed and undirected distances: The circle: General equation and equation at a tangent at a point of contact and from an external point: Polar coordinates and their definitions, relationship with Cartesian coordinates, graphs and equations: Ellipse parabola and hyperbola: Equations in standard form and with change of origin: Chord, tangent and normal including parametric form: Vectors: In two and three dimensions; addition, subtraction, multiplication by scalars, resolution, scalar and vector products; velocity and acceleration vectors. Applications to plane trigonometry, geometry of straight line in two and three dimensions, curve in two dimensions, and resultant force and velocity.

ECU 105: ENGINEERING MATHEMATICS II

Algebra: Surds, logarithms and indices: Quadratic functions, equations and inequalities; exponential functions; trigonometric functions, graphs and inverse for degree and radian measure, addition multiple angle and factor formulae; trigonometric identities and equations; Sine and Cosine rule; standard trigonometric formulae: Hyperbolic functions; Sinh and Cosh, Hyperbolic Identities (Osborne's rule): Permutations and combinations: Binomial theorem and its application: Remainder theorem and its applications to solution of factorisable polynomial equations and inequalities: Complex numbers: arithmetic operations and geometric representations; modulus; arguments; De Moivre's theorem; applications: Roots of complex numbers; Hyperbolic functions; properties; graphs; identities.

EEE 100: ENGINEERING DRAWING I

Various aspects of graphic language: Aesthetic, artistic and Technical Drawing: Drawing in relation to design and production: Technical Drawing equipment for pencil work and ink work drawing, paper size, lines, lettering, numbering and titling: Applied geometry: Construction of Loci, threads, cams and gear teeth profiles: Orthographic projection of simple objects, first and third angle projections: Dimensioning: Pictorial drawing: Isometric, Oblique and perspective: Auxiliary views; true length of a line, true shape of a surface, true inclination of angles; development; interpenetration of geometric solids: Curves of interpenetration.

ECU 102: CHEMISTRY FOR ENGINEERS II

Properties of gases: Physical equilibria: Raolt's Law; Solid-liquid equilibrium (SLE); Colligate properties; Liquid-liquid equilibrium (LLE); Chemical equilibria: Reversible chemical reaction, equilibrium, Le-Chatelier's principle: Ionic equlibria, pH and buffer solutions; theory of acid/base indicators: Solubility and solubility products. Kinetics-Reaction Rates: Concentration and Rate, Reaction Mechanisms; Electrochemistry: half reactions, Galvanic Cells, and electrode potential, electromotive force (emf) of a cell: Practical on measurements of heat of dilution, reaction, neutralisation, potentiometer titration, pH, vapour pressure determinations and solubility product.

ECU 103: PHYSICS FOR ENGINEERS II

Coulomb laws; electrical field and potential; capacitors; dielectrics; current and resistance; DC circuits; magnetic fields; electric measurement instruments; Ampere's and Biot-Savart law; induced electromotive force; electromagnetic induction; transient currents; AC circuits: Electromagnetic waves and photo reflection and diffraction; mirrors and prisms; scatter lenses and optic instruments; photometry; interference; diffraction and polarization; Particle and wave theories; phenomena of, and explanation of atomic spectra; X-rays.

ECU 106: ENGINEERING MATHEMATICS III

Vectors: Coordinate systems, length of a vector, dot products, equations of lines and planes; cross products, algebraic properties, scalar triple products, vector moment, vector triple product. Linear Equations: Solution of linear equations, matrices and matrix algebra and operations, Cramer's rule; identity matrix, inverse and adjoint matrices and determinants,

Gaussian elimination, singular matrices; sums and products of matrices. Eigenvalues and eigenvectors: Definitions; matrix diagonalizations; powers of matrices; use in matrix properties; application of eigenvalues and eigenvectors to physical systems. Boolean algebra: Laws, Truth Tables, OR, NOT, AND logic gates, inverse- truth tables, design of basic switching circuits.

ECU 107: ENGINEERING MATHEMATICS IV

Derivatives: Notations and definition; limits; differentiation by first principles; functions continuity, differentiability of functions; sums, product, quotients, and chain rule; derivatives of algebraic, logarithmic, trigonometric, hyperbolic and exponential function of a single variable; higher order derivatives; parametric and implicit differentiation. Applications of derivatives: Small change, slopes, tangents and normals, rates of change; maxima, minima and points of inflection; sketching graphs of functions; Newton's Method for numerical solution of equations; Taylor series and approximations. Integration: Reverse differentiation; definite integrals and areas; indefinite and improper integrals; differentiation and integration of complex functions; Applications of integrals: Volumes, moment of inertia.

EEE 101: ENGINEERING DRAWING II

Detail drawing of machine parts; interchange ability: Tolerance; limits and fits; selection of tolerances: Machining symbols and instructions on drawing: Conventional representation of features using KBS, BS 308, ISO 45000 codes of drawing practice: Sectional views: Aligned and partial views; intersections in sectioning; conventional breaks: Assembly drawings; Working drawings; electrical circuits drawing, pipe work diagrams.

EEE 102: COMPUTER PROGRAMMING I

Program design concepts: Algorithm, modular, design, program structures, flow charts pseudocode, topdown design, stepwise refinement: High level programming languages, commercial, oriented, scientific and special purpose: Structured programming and object oriented programming: Program compilation; compiler facilities; linking; input/output modes, text and graphics modes: Designing a user interface assemblers and interpreters.

ECU 108: INTRODUCTION TO THE ENGINEERING PROFESSION

History of engineering. Infrastructural aspects of engineering. The engineer and society: safety, relationship with government, clients, and the professional team. Introductory lectures in the diverse areas of engineering offered by different departments of the School of Engineering and Technology: Electrical building services, power systems, control, telecommunications, electronics, computing, data networks & the Internet; Civil - structures, highways, water systems and other public works; and Mechanical - building services, machinery and equipment. Engineering tasks: data collection, analysis and presentation, planning, design, supervision, operation, maintenance. Reports and associated documents. Examples of engineering projects; Safety issues in and environmental impacts of engineering projects. Group work. Problem analysis, formulation of alternative solutions; preliminary design. Guest lectures and/or industrial interface addressing topics Innovation, Product Development, Multi-Disciplinary Projects and Sustainability. Communication, audience and structure; Giving presentations and making slides; Constructing text from paragraphs; Style and structure; Laboratory reports; Introduction to management;

Individuals at work; Power and politics in organisations; Organisational culture; Vision and positioning; Firm boundaries and core competences; Strategy process.

ECU 200: ENGINEERING MATHEMATICS V

Techniques of integration: Powers of trigonometric functions; standard subscription including trigonometric and hyperbolic functions and partial fractions, integration by parts: double integrals and change of order of integration: Applications of integration: Kinematics of simple harmonic motion and oscillators, arc length, plane and surface area, and volume in Cartesian coordinates: Mass, Moment and Centre of mass; Sequences and Series: Sequences and Convergence, Infinite series, Power series, Taylor and Maclaurin series, Binomial theorem and binomial series. L'Hopital's rule. Rolle's Theorem. Numerical integration: Euler, Trapezoidal, Mid-ordinate, and Simpson's rules.

EEE 200: INTRODUCTION TO MATERIAL SCIENCE

Structure, crystallography and solidification of material, alloys, ceramics, glasses and polymers: Micro and macro structures: Crystal structure metals: Mechanical properties: Cooling curves: Alloy theory and equilibrium diagrams: Iron properties and methods of production; iron carbon phase diagrams; types, properties, uses and heat treatment of plain carbon steels; stainless steels and cast iron: Mechanical properties; Ductile-brittle transitions. Fracture, toughness. Strengthening methods: Non-destructive testing techniques: Environmental effects on material; corrosion and photo damage; Thermal, optical and electrical properties.

EEE 201: THERMODYNAMICS

The concept of the zeroth law of thermodynamics: Concept of state functions: Work, heat, internal energy and Enthalpy: First law of thermodynamics: Steady flow energy equation, applications to boilers, condensers and turbines: The concept of heat engine and a heat pump: Second law of thermodynamics; entropy; thermodynamic temperature; thermodynamic properties of steam (steam tables and Mollier diagram) Power production: Carnot and Rankine Vapour power cycles; steam power plants performance: A simple refrigeration cycle: Heat transfer: Modes of heat transfer, Fourier's Law; One dimensional, conduction through composite walls, and axi-symmetric heat conduction: Natural and forced convection: principles, heat transfer coefficient and its use: Radiation: Black and grey body radiation. Heat exchangers: types and determination.

EEE 202: COMPUTER PROGRAMMING II

Programming in high level languages: Data type and declarations, statements expressions and assignments: Constants, variables, arrays, relations, arithmetical, logic operations and expressions decisions and loop control structure, input and output statements functions and procedures: Interactive programming structures; data structures; non-procedural structures and commands: Application of high-level languages to scientific problems.

EEE 203: CIRCUIT THEORY I

Basic Circuit Concepts and Components: Resistor, Inductor and Capacitor. Impedance Z: Resistance R, Capacitance C and Inductance L: AC and DC sources: Voltage sources and Current

Sources: Circuit elements in series and in parallel: Steady-state linear DC circuit analysis: Techniques of circuit analysis: Kirchhoff's laws, superposition theorem, Thevenins theorem, Compensation theorem, reciprocity theorem. Maximum power transfer: Steady-state single-phase AC circuit analysis: Sinusoidal excitation and phasors, admittance and conductance: Average and effective value of A.C waveforms, node and mesh circuit analysis: A.C steady state analysis, node voltage network analysis: Thevenins and Nortons theorems in a.c. Networks: Computer Aided Circuit Analysis: Introduction to the use of Computer-Aided Design (CAD) tools such as PSPICE for AC and DC circuit simulation and analysis.

EEE 205: PHYSICAL ELECTRONICS

Atomic structure and Quantum concepts: atomic structure, energy levels in an isolated atom, quantization, inter-atomic forces, bonds and bands: Schrodinger wave equation: Potential wave problem: Electrical conduction; Electrical conduction in metals, classical and quantum free electron theories, band theory, distinction between metals, insulators and semi-conductors, intrinsic and extrinsic semi-conductors; intrinsic and extrinsic semiconductors: Fermi energy; conductivity and its variation with temperature; experimental techniques for determination of the energy barrier: Currents in a p-n junction: the diode equation; junction capacitance, the aviator diode, characterization of the junction; tunnelling phenomenon; physics of the solar cell and the light-emitting diode. Gaseous and Plasma Processes: arc, glow discharges.

ECU 201: ENGINEERING MATHEMATICS VI

Definition of Statistics: Data collection; Data presentation techniques, Distribution functions including, Gaussian, Binomial, Poisson, Normal, Gamma, student's and F distributions normal and distributions, ChiSquare Distribution. Sampling: Sampling errors, Estimation of population parameters. Correlation: Simple linear correlation coefficient, Regression coefficient, Forecasting, Determination coefficient. Definitions of Probability, Axiomatic Probability; Conditional, Probability and Independent Events; Bayes Theorem; Concept of Random Variable; Univariate Probability Distributions; Expected Value and Variance; Conditional Probability Distributions; Trans-formation; Probability Generating Function, Characteristic Function, Moment Generating Function; Some Special Discrete and Continuous Probability Distributions.

EEE 212: MECHANICS OF MACHINES

Strength of materials: Forces, stress and shear stress, strain and shear strain: Types of loading: compression, tension, torsion and bends: Concentrated and distributed loads and bending moments in straight beams: Cantilevers: Simple supported beams: Points of infection: Graphical construction of bending moment diagrams: Stresses in beams pure bending of a rectangular beam: Bending a beam about a principal axis: Two axes of symmetry, one axis of symmetry: Elastic section modulus: Principal second moment of inertia combined bending forces. Introduction to mechanisms: Kinetics and kinematics of rigid bodies and plane mechanisms: Vibration and vibration damping: Power transmission: Gears application in power transmission; types of gears and tooth profiles; screw threads; types and construction; belts and pulleys; chain and sprockets.

ECU 202: ENGINEERING MATHEMATICS VII

Differential Equations and their Solutions: First Order and First Degree Differential Equations: Exact differential equations and integrating factors; Separable and homogeneous equations, Linear equations: Applications of First Order and First Degree Differential Equations: Geometrical problems, Surfaces and curves in three dimensions, Orthogonal trajectories, Oblique trajectories. Higher Order Linear Differential Equations and Applications: Second order linear equations, characteristic equation and complex roots; non-linear equations and separation of variables; Laplace, Poisson, heat and wave equations, methods of the solution by separation of the variables for Cartesian, spherical polar and cylindrical polar coordinates: Linear Systems of Differential Equations.

ECU 203: ENGINEERING MATHEMATICS VIII

Laplace Transform: Definitions and notation; transforms of powers, exponential and trigonometric functions; scales, shift and factors rules; inverse transforms, application to Heaviside and Delta functions and solution of differential equations; Transfer functions, convolution theorem and discrete systems: Fourier series: Periodic functions, including sine and cosine series, determination of coefficients, even and odd functions: Fourier Transform (FT) and non-periodic functions: Properties of FT and Transform rules including on differentiation, convolution theorem, delta and Dirac functions: Solutions of Differential Equations by Laplace Transform and Fourier: Special functions: Bessel functions, Legendre Polynomials; Gamma functions.

EEE 204: CIRCUIT THEORY II

Series and parallel resonance, Q-factor and tuned circuits: Single, Two and Three phase Star-Delta transformation: Single, Two and Three phase systems: Power and power factor: Mutual inductance and coupled circuits: D.C. and A.C. Transients: Introduction to matrix methods: Graph theory: signal flow graphs and computer application to solution of networks: Use of Computer-Aided Design (CAD) tools such as PSPICE and MATLAB for circuit simulation and analysis.

EEE 206: ELECTRICAL MACHINES I

Magnetic circuits and materials: magnetic circuits, materials, hysteresis loop.Kirchhoffs Laws applied to magnetic circuits, self and mutual inductance. Induced e.m.f. Stored energy. Flux m.m.f. relationship in magnetic circuits and stored energy. Electro-mechanical energy conversion principles: Conversion of energy from a mechanical to electrical form, conversion of energy from electrical to mechanical form. Energy balance equation of an electromechanical system. Force and torque as rates of change of stored energy. DC machines: types of DC machines (motors and generators), constructional elements; windings, e.m.f. and torque equations; armature reaction; commutation; energy losses and efficiency. Performance characteristics of separately excited, Series and compound machines, DC motors. Construction of a starter, Speed control by variation of armature reaction. Effect of brush shift. Calculation of magnetizing and cross-magnetizing ampere turns. Losses in DC machines - determination of efficiency. Single Phase Transformer: Principle of action; Equivalent circuits and phasor diagrams of single-phase transformer. Useful and leakage uxes; leakage reactance; voltage

regulation; losses and efficiency. Transformer maximum efficiency and regulation. Polarity test; open-circuit and short circuit tests

EEE 207: DATABASE MANAGEMENT SYSTEMS

Database models, relational, object-oriented, hierarchical, and network. Database system planning, analysis, design, development and implementation. Role of database administrator. Application development using a typical relational database product such as visual basic.

EEE 208: ELECTRICAL MEASUREMENTS

International Standards of Units (SI): Natural constants and their application in measurements: Primary standards: Elements of a measurement system: accuracy, precision, sensitivity of instrument: Sources of error: Error analysis: Transducers; resistive, capacitive, inductive, optical, thermal etc: Analogue instruments: Digital instruments: Instrument transformers: Alternating current/direct current (AC/DC) bridges: Cathode ray oscilloscope (CRO): Calibration of instruments: Measurements of voltage, current, charge, resistance, inductance, capacitance, phase angle, frequency, power and energy: Magnetic measurements: AC/DC conversion.

EEE 209: FLUID MECHANICS

Properties of fluids: Hydrostatics: forces and centre of pressure on plane surfaces: Hydrodynamics: Types of flows-Steady and non-steady flow; continuity equation, fluid viscosity, boundary layers and velocity profiles, laminar and turbulent flows conditions: Bernoulli equation, flow in pipes, pressure losses; flow measurements, pitot tubes, orifices, venturimeters, weirs, coefficients of discharge: Fluid flow machinery: Energy flow analysis, velocity diagrams; classifications-pumps, fans, turbines and compressors.

EEE 210: AUTOCAD

Launching AutoCAD: AutoCAD menus, user interface, screen layout, drawing setup procedures, function keys: Basic 2D drawing creation commands, file management commands, setting drawing precision, coordinate input systems, editing commands and features, setting and using layers, inquiring about drawing information, introduction to block creation, hatching, introduction to dimensioning techniques, drawing template creation, object snaps, display manipulation commands for object viewing, basic editing techniques, text annotation creation and usage, basic plotting techniques in model space and with paper space layouts, page setups and plot style tables.

EEE 213: WORKSHOP PRACTICE

This will take twelve (12) weeks at the end of the second year of study. The students will follow an approved practical training schedule designed by the department. The training will take place in Mechanical Engineering, Electrical Engineering and Computer Engineering workshops and laboratories. Mechanical Engineering Workshops: safety, practical exercises on use of machine tools, fitting and hand tools, welding and joinery-including soldering brazing, arc and gas welding-plumbing, masonry, carpentry, automotive engineering, and foundry: Electrical Engineering Workshops: Safety, Electrical Installations, Soldering and fabrication of simple electronic circuits on printed circuit boards, Winding of Motors and Transformers, Electrical Measurements and Standards. Computer Workshops and Laboratories: Safety, basic

maintenance of computers.

3.3 Level 300

EEE 300: ELECTRICAL MACHINES II

Three-phase transformers: Review of single phase transformers. Three phase transformer winding, connections, groupings, operation. Effect of harmonics on output wave forms. Paralleling and load sharing. Scott three-phase to two-phase connection and Scott three-phase to single-phase connection; instrument transformers; operation on in- finite bus bars; rating; heating; temperature rise; cooling; losses and efficiency. Testing and application. Three phase induction motors: Operation, equivalent circuit, circle diagram, performance and characteristics, balance steady state operation, methods of starting and braking. Speed control. Testing and applications. Single phase induction motors: Types of single-phase induction motors, double field revolving theory, Self-starting mechanism, equivalent circuits, Capacitor Startand-run motor, shaded pole motor, repulsion type motor, repulsion type motors, AC series motor, Universal motor, Reluctance motor, Hysteresis motor.

EEE 302: ELECTROMAGNETIC FIELDS

Electrostatics: Coulombs Law; electric field intensity: Electric potential; electric dipole; Gauss Law; potential energy; spherical, linear, planar charge distribution: Dielectrics, Conductors and Semiconductors: Boundary conditions at conducting surface, and on dielectric boundaries: The electric field in dielectric media, polarization, energy in a capacitor: Fields in a coaxial transmission, capacitance per unit length: Divergence of flux density: Maxwells divergence equations: The Divergence theorem: Laplacian operator: Poissons and Laplaces equations: Boundary value problems: Solution of Laplaces and Poissons equations in different co-ordinate systems with examples of practical situations: Electric Fields: Electric polarization; electric field inside and outside dielectrics; electric susceptibility; electric displacement: Magnetostatics: solution of magnetic fields; Biot-Savart Law; force between current carrying conductors; magnetic induction; Amperes law; the toroid; the solenoid.

EEE 305: DIGITAL ELECTRONICS I

Overview of Digital Systems: What are digital systems? Comparison of Analogue and Digital systems, Advantages of Digital Systems, Applications of Digital Systems, Number systems and Codes: Binary, Octal, Decimal and Hexadecimal number systems: their inter-conversions and applications: Signed binary numbers: sign-magnitude notation, 1s and 2s complement notation - properties and applications: Binary number codes: BCD code, Excess-Three code, Gray code-properties and their applications Boolean algebra and logic gates: Basic operations of Boolean algebra; AND, OR, NOT: Logic gates; AND, OR, NOT, NAND, NOR, XOR and XNOR gates; logic symbols and truth tables: Laws of Boolean algebra, proving laws of Boolean algebra: Canonical forms: Introduction to Hardware Development Language (HDL). Combinational logic circuits Simplification of Boolean expressions: algebraic and Karnaugh map method: Don't care terms: NAND/NOR gate circuit implementation: Systematic SSI IC-based circuit design: HDL for combinational logic circuits and sequential logic circuits: Flip-flops SR, D, T and JK flipflops, truth tables and excitation tables: Clock signals and clocked flip-flops, Master-slave flipflops. Derivations of one flipflop function from another: Asynchronous and synchronous counters:

Registers: HDL for sequential logic circuits: Logic families and their characteristics: TTL, ECL, MOS and CMOS logic families; circuit diagrams, characteristics and specifications: Tri-state devices, open-collector outputs: Recent developments in logic family technologies.

ECU 300: ENGINEERING MATHEMATICS IX

Vectors and Coordinate Geometry in 3-D Space. Vector Functions and Curves. Functions of Several Variables and Partial Differentiation and its applications. Multiple integration: Double integrals, Triple integrals, Applications of multiple integrals. Vector fields: Scalar and Vector Fields, Conservative Fields, Line Integrals of Vector Fields, Surface and Surface Integrals. Vector Calculus: Gradient, Divergence, Curl. Green's Theorem, The Divergence Theorem, Stoke's Theorem; curvilinear coordinates in two and three dimensions.

EEE 308: ANALOGUE ELECTRONICS I

Introduction to semi-conductors and diodes: Characteristics of the p-n junction, p-n junction diodes: Application of diodes in rectification: Zener diodes characteristics, Zener diode voltage regulators: Bipolar junction transistors: NPN and PNP Bipolar Junction Transistor (BJT) characteristics and biasing: Equivalent circuits of Bipolar Junction Transistors: Ebers Moll model of a BJT Bipolar Junction Transistor amplifiers (Common Base; Common Emitter; Common Collector): Field Effect Transistors: Junction Field Effect Transistors and Metal Oxide Semiconductor Field Effect Transistors: Biasing and equivalent circuits of Field Effect Transistors: Field Effect Transistors amplifiers: Common Gate, Common Source Common Drain: Biasing and Bias Stability: DC and AC load lines Operating Point - Q point variation - Various biasing methods to stabilize the operating point stability factor; Compensation Techniques; Bias stability in FET circuits; Biasing MOSFETs: Transistor Small Signal Models: Two-port representation of a transistor; h-parameters and their determination: Analysis of transistor amplifiers using h-parameters; Calculation of voltage gain, current gain, power gain, input and output impedance using exact and approximate h- parameter models; The z and y parameter models: The y-parameter equivalent circuits of a JFET: Small signal analysis of FET amplifiers.

EEE 310: CONTROL SYSTEMS I

Introduction to linear control systems: Basic concepts open and closed- loop systems, examples of simple systems: Classification of systems; linear/nonlinear; continuous time/discrete-time; time variant/time invariant; SISO/MIMO: Order and Type of systems: Feedback Control Systems: Closed- loop systems, positive feedback and negative feedback, effects of feedback on system response, advantages and disadvantages of feedback: Mathematical modelling of control systems: Representation using differential equations: The transfer function, poles, zeros and impulse response: Block diagrams, signal flow graphs and Masons Rule: Transient and steady-state response: Transient and steady-state response of systems with emphasis on first-order and second-order systems: Time domain specifications of second order systems delay time, rise time, peak time, maximum overshoot, settling time: Steady-state error analysis: Computer-aided simulation of system response to standard test inputs; impulse, step and ramp: Stability: Stable and unstable systems, characteristic equation, and location of the roots in the s-plane for stability. Rouths stability criterion: Root Locus method: Root loci, plotting of root loci: Interpretation of the root-locus: System design using

root loci: Computer-aided plotting of root loci: Frequency response: Bode plots, gain and phase margin: Nyquist plots, stability, gain and phase margin: Nichols charts: Computer-aided plotting of Bode and Nyquist plots: Control System Modelling, Simulation and analysis using computer-aided control engineering software such as MATLABs Control, Systems Toolbox and SIMULINK, and Case Studies.

EEE 304: ELECTRICAL ENGINEERING MATERIALS

Electrical properties: conductors, insulators, super conductors: Semi conduction in amorphous material: Dielectric, ferroelectric, piezoelectric, pyro-electrics and thermoelectric materials, magnetic electrics: Electrostriction: Ferro and ferrimagnetisms: Metals, alloys, ceramics Paramagnetism: Domain theory: Remanence coelecricivity; permeability: Support materials, encapsulating materials, and protective coatings, tubing and sleeving materials: Adhesive materials: Insulating materials: Printed circuit boards materials: Metalized ceramics: Etching and cleaning: Stability of materials.

ECU 302: INNOVATION AND ENTREPRENEURSHIP FOR ENGINEERS

Definition, Types of entrepreneurs, characteristics of Entrepreneurs. Role of entrepreneurs in economic development. Various sources of business opportunities. Identification of commercially viable business propositions. Business plan formulation. Sources of funding. Government policies on small business ventures, enterprising opportunities; Motivation, competencies and skills. Starting new business ventures; Business planning, Resource managements, organization development and management financial management and planning. Marketing, selling and negotiation techniques. Exit options for Engineers.

EEE 315: ELECTRICAL MACHINES III

Three phase synchronous machines: equivalent circuits, performance and characteristics. Short circuit ratio, saturation effects, power and power angle diagrams. Paralleling: behaviour on infinite bus bar system, effect of change of excitation on power factor. The synchronous phase modifier, O and V curves, determination of kVA. Armature reaction in synchronous machines: two axes theory for both synchronous motor and generator. Stability in synchronous machines: steady state transient and dynamic stability, equal area criterion of stability, short circuit and negative sequence conditions. Electrical and mechanical load operating charts, limits of stability. Governor characteristics: oscillations and hunting.Methods of improving stability of synchronous machines.

EEE 307: NETWORK ANALYSIS AND SYNTHESIS

Network Concepts: Network Topology, Graph Theory: Incidence matrix; mesh, loop, and tree; cut-set, directed graph; circuit matrix, cut-set matrix; fundamental circuits and cut-sets: Network Functions: Driving-point functions; driving point impedance; two-port parameter matrices; transfer polynomials, polynomial composition of network parameters: Passive network synthesis: Introduction to concept of positive realness; test for positive realness; Huruwitz polynomials, Cauer synthesis; Foster synthesis: Filter Concepts: filter parameters and approximation techniques: Butterworth, Chebyshev, Elliptical, Bessel approximations: Filter design using image parameters and other appropriate methods: Frequency and impedance transformation: Normalization: Introduction to active filter design.

EEE 303: POWER SYSTEMS I

Introduction to electrical power systems, Sources of electrical energy, Generation, transmission and distribution of electrical power. Transformers. Three phase transmission system. Steady-state operations. Single line equivalent circuit of star-and delta connected loads. Application of per unit quantities. Tariffs. Power Factor and power factor correction.

EEE 306: DIGITAL ELECTRONICS II

Medium-Scale-Integrated (MSI) devices and their applications: Decoders, Encoders, Multiplexers, Demultiplexers, Adders and Subtractors, Magnitude Comparators: HDL for MSI circuits: Memory devices: Semiconductor memories: ROMs, PROMs, EPROMs, EEPROMs, Flash memories, PLAs and PALs, static RAM, dynamic RAM, CCD memories, FPGAs and ASICs: Expanding word size and capacity: Applications of different memory devices: Sequential logic circuits: Analysis of sequential logic circuits using state equations, state tables and state diagrams: State reduction: Design of sequential circuits: HDL for sequential logic circuits: Timing circuits; Astable and monostable multivibrator circuits and their applications, crystal oscillator circuits: Analogue-to-Digital (A/D) and Digital-to-Analogue (D/A) conversion: Basic concepts, D/A conversion: weighted resistor DAC, R-2R ladder DAC. A/D conversion: Digital ramp DAC, successive approximation DAC, dual-slope ADC, Flash ADC: General ADC and DAC specifications and applications: Introduction to microcomputers and microcomputer organization: Microcomputer components and the working of a microcomputer, working of a microprocessor, types of microprocessors, programming model of a microprocessor, basic concepts of microprocessor interfacing.

EEE 309: ANALOGUE ELECTRONICS II

Transistor Small Signal Models: Two-port representation of a transistor; h-parameters and their determination: Analysis of transistor amplifiers using h-parameters; Calculation of voltage gain, current gain, power gain input and output impedance, using exact and approximate h-parameter models; The z and y parameter models: The y-parameter equivalent circuits of a JFET: Small signal analysis of FET amplifiers Feedback in Transistor Amplifiers feedback in amplifiers effects of negative feedback; positive feedback and oscillations; Hartley and Colpitts oscillators: Frequency Response of Amplifiers Frequency response of RC coupled amplifiers; Low frequency effects of Coupling and Bypass capacitors; Amplifier at high frequencies; Miller capacitance; The Ideal Operational Amplifier: The ideal operational amplifier (op amp) characteristics, addition, subtraction, differentiation, and integration using op amps: Power Amplifiers: Circuit Simulation: Simulation of Transistor amplifiers using computer-aided design (CAD) tools such as PSPICE.

EEE 311: CONTROL SYSTEMS II

PID controllers: P, PI, PD and PID controllers: characteristics and their application: Electronic realizations of PID controllers. Ziegler-Nichols rules for tuning PID controllers: IntegratorWindup: Analysis and design of PID control systems using a computer aided control engineering tools such as MATLABs Control Systems Toolbox and SIMULINK. Compensation In The Frequency Domain: Lag and lead compensation in the frequency domain: Frequency response design and analysis using a computer-aided control

engineering tool such as MATLABs Control Systems Toolbox. State Space representation: State-space models of Linear-Time-Invariant (LTI) SISO: Systems and terminology: Obtaining state-space representation from transfer functions; control canonical form, observer canonical form, diagonal/Jordan canonical form: Obtaining transfer-functions from state-space representations. Properties of state-space models: Eigenvalues, Zeros, Non-uniqueness of state-space models, Invariance of eigenvalues under similarity transformation: Solution to the state equation: Solution to the homogeneous and non-homogeneous state equations, Computation of the matrix exponential, the State transition matrix and its properties: Controllability and Observability: Concepts of controllability and observability: Numerical tests of controllability and observability by Kalman: Controllability and observability tests by Gilbert: Structural Controllability: Reachability: State variable feedback: (design by pole placement): Pole placement design methods when the system has no external inputs.

EEE 313: TRANSMISSION LINES AND WAVE GUIDES

Guided Waves: Maxwell equations; differential and integral forms: Uniform plane waves; magnitude and direction; in vacuum, conductivity and non-conductivity media: Guided wave system overview; open-wire lines, coaxial lines, parallel plates and circles pipe: Waveguides; waveguide modes; Transverse electric, TM, Transverse TEM: Waveguide properties; wavelength, velocity of propagation, impendence, cut-off, polarization, reflection and refraction: Poynting theorem and power consideration: Field concepts in relation to lumped circuit's elements. Transmission lines: Line parameters, analysis of distributed line contacts: Phase and group velocities: Dispersive and non-dispersive circuits: Concept of position angle: Analysis of current and voltage distribution along a transmission line, reflection coefficients and VSWR Lossless line equations: Lossy short-circuit line: Measurement of reflection coefficient: Smith Chart: Impendence matching using a stud: Resonant and anti-resonant lines: The quality factor of resonant and anti-resonant lines.

ECU 301: ENGINEERING MATHEMATICS X

Interpolation: finite difference, linear, quadratic and lagrange methods and their applications in numerical differentiation. Newton-Raphson formula for obtaining an approximate root of an equation. Numerical integration; trapezoidal and Simpson's rules, Newton-cotes and Romberg formulae, and Gaussian quadrature. Numerical solution of ordinary differential equations; Taylor's series, Euler, Runge- Kutta, Milne, predictor-corrector and extrapolation methods.

ECU 303: INDUSTRIAL PRACTICAL ATTACHMENT I (12 WEEKS)

This will be at the end of their third year of study and will involve relevant organizations and industries. The student will be attached to an organization and be a part of the work force. They will participate in all activities related to: Routine office work, field work, workshop work, and any other work as may be assigned by the field supervisor. The student will be required to complete 12 weeks of the attachment. The student will be required to maintain a log-book which will be issued by the centre for Career Development. This will be the basis of the assessment when the students reports back at the university.

EEE 400: COMMUNICATION SYSTEMS I

Basics of a communication system: Basic components of a communication system (transmitter, transmission medium, receiver), types of communication systems (analogue,

digital, point-to-point, point-to-multipoint, broad- casting, simplex, half-duplex, full-duplex). Limitations of communication systems: bandwidth limitations, attenuation, noise, time delays. Amplitude (Linear) Modulation: Baseband and Carrier signals. The complex envelope. Amplitude Modulation: Double Sideband (DSB), Amplitude Modulation (AM), Quadrature Amplitude Modulation (QAM), Single Sideband (SSB), Vestigial Sideband (VSB). AM transmitters, low and high level, oscillators, amplifiers and modulators. AM receivers, detection, Tuned RF (TRF) re- ceivers, Superheterodyne Receivers, Double Conversion AM receivers.

ECU 401: PROJECT MANAGEMENT

Feasibility studies. Project planning. Project scheduling: Gantt Charts; Project Evaluation and Review Techniques (PERT): Critical Path Method (CPM), Critical Path Analysis (CPA). Financial and economic appraisal of projects; discounted cash flow. Project control, monitoring and evaluation. Elements of operation research: Decision theory, decision trees and linear programming. Case study. Project Reporting.

EEE 402: COMPLEX ANALYSIS FOR ELECTRICAL ENGINEERS

Theory of functions of a complex variable, definitions and theorems, integration in the complex plane, continuous and discrete transformations, z-transformation and modulation: Complex variable functions, Cauchy-Riemann formulae, singular points, poles, Laurent series, residues, residue theorem, calculation of definite integrals, conformal mapping: Joukowsky transformation.

EEE 403: ANALOGUE ELECTRONICS III

Differential Amplifier and Op amps: The differential amplifier and its characteristics: The ideal op amp: Feedback configurations: Concept of virtual ground: Circuit diagram of a simple op amp: The Practical Op amp offset voltages and bias current: Common mode rejection ratio: Frequency response and stability: Compensation techniques: Slew rate and full-power band-width: Gain, input impedance and output impedance: Inverting and non- inverting configurations: Linear Op-amp Circuits: Active integrator; effect of finite gain, effects of offsets on performance: Active differentiator; Stability: Analogue simulation: Basic op amp Difference amplifier; Instrumentation amplifier: Voltage to current and current-to-voltage converters: Non-Linear Op-amp Circuits: Voltage comparators; Multivibrators; Sinewave generators; Function generator; Precision rectifiers; Log and antilog amplifiers; Voltage clippers and clampers; Sample and hold circuits; multipliers and dividers; programmable transconductance amplifiers. Power amplifiers (class A, class B, class AB and class C)

EEE 405: POWER ELECTRONICS

Physics and characteristics of semi-conductor power devices: Device rating, thermal considerations and cooling techniques: MOSFET, SCR, Power diodes, IGBT. Rectification: Rectifier circuits and their characteristics. Out- put voltage ripple. Smoothing methods. Operation with resistive and inductive loads. Single and poly-phase half and full-controlled bridge rectifiers. Freewheeling diode. Application of power switching circuit in control of ac/dc loads. Forced commutation. Definitions and classifications. Direct-Alternating Current conversion: DC to DC converter: buck, boost, buckboost, CUK. Control of DC power supply system with reversible power . Choppers and inverters:

analysis and design. Inverters: resonant, pulse width modulation types, series, parallel, impulse-commutated. Harmonic contents of input and output. Computer simulation of power converter system. Microprocessor control of power electronic equipment.

EEE 406: MICROPROCESSOR SYSTEMS AND APPLICATIONS

Microprocessor Architecture: The ideal microprocessor; practical limitations; the data bus, address bus, control bus; central processing unit architecture. Internal registers. The Arithmetic Logic Unit. Instruction word flow. Data word flow. State transition diagram. Microprocessor Instruction Set: Addressing modes. Status register. The binary code. Hexadecimal code. Flow charts. Opcodes. Fetch machine cycle. WRITE and READ machine cycle. Interrupt, Acknowledge. Timing diagrams. Address allocation techniques. Address decoding techniques. Memory organisation and memory management. Assembler, compiler, loader, monitor, and other software aids. Assembly language. Programming illustrated with an example microprocessor. Interfacing Techniques: Interfacing the decoder, static RAM with programmable Input/ Output ports. ROM, EPROM with Input/Output. Central Processing Unit - initiated conditional and unconditional Input/Output transfers. Device-initiated interrupt Input/ Output transfer. Direct Memory Access. Applications: Microprocessor Selection. Design Methodology. Simple Examples of Applications.

EEE 404: POWER SYSTEMS II

Standard parameters and equivalent circuits of power system Components: synchronous machines, overhead lines, underground cables, transformers and loads. Purpose and characteristics of transformers. Switch-gear; Circuit breakers; Isolators; insulators; bushing. Generalised circuit constants. Power transmission: single phase and three phase transmission, complex power, load characteristics, per unit system. Constants of transmission lines: resistance, inductance and capacitance of single and three phase lines. Performance of transmission lines: short, medium and long lines. Symmetrical components and fault calculations: Three phase system; Significance of positive, negative and zero-sequence components; sequence impedance network equations. Phase shift. Delta-star transformations. Reactors, short-circuit capacity of a bus. Unsymmetrical fault calculation: single line to ground: double lines to ground: Line to line. Faults in power systems. Effects of neutral grounding of faults on three-phase system. Effects of neutral impedances on fault currents. Zero sequence diagram. Faults with broken conductors. Unbalanced operation of three-phase transformer.

EEE 410: SIGNALS AND SYSTEMS

Classifications of signals and systems: Signals: Analogue and Digital, Continuous time and discrete-time, Periodic and Aperiodic, Even and Odd signals, random and deterministic, Energy and Power signals: Signals and vectors: Unit Step, Unit Ramp and Unit Impulse signals: Systems: Linearity, time in- variance, causality, invertibility: Time domain representations of signals and systems: Convolution integral for continuous time signals: Fourier Analysis: Fourier Series and Transforms, Inverse Fourier transform and properties, Fourier transform of common signals, Properties of Fourier Series and Transforms, Parsevals Theorem, Power spectral density and energy: Spectral density: Laplace Transform: Laplace transform (including region of convergence), Laplace transform of common signals, inverse Laplace transform

(including partial-fraction expansion), and properties, Poles and zeros in the s-plane, Solving differential equations with non-zero initial conditions via Laplace transform: Fundamentals of Sampling: Conversion of continuous-time signals to discrete-time signals by sampling, sampling theorem, Shannon/Nyquist sampling rate and ideal reconstruction, Effects of under sampling: Random Signals and Noise: Random signals and their characterization. Random processes; normal, uniform, binomial: Stationarity and ergodicity: The auto-correlation function, Power spectral density of random processes: Modulation: Amplitude Modulation, Frequency Modulation

EEE 401: COMMUNICATION SYSTEMS II

Pulse Modulation: Filtering, Sampling and Quantization. Encoding of analogue signals for transmission over digital systems: Pulse-Code Modulation (PCM), Diferential Pulse Code Modulation (DPCM), Delta Modulation (DM). Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM). -LAW and A-LAW of coding processes. PCM signal multiplexing. Bit, word and frame synchronization, Quantization noise, Transmission noise and probability of error. Inter-symbol interference (ISI). Overall signal-to-noise ratio for PCM systems, Threshold efect. Channel capacity. Digital Modulation Schemes: Digital modulation techniques, Performance of various modulation techniques, Spectral efficiency, Error-rate, Power Efciency, Band pass data transmission systems - ASK, PSK, FSK, QPSK, DPSK, MSK, QAM, Signals, detection techniques, receiver implementation and probability of error, Performance analysis. Data Compression Techniques: Shannons Law, Channel capacity, Prediction filter, Diferential PCM, Delta modulation (DM), Quantization noise, Slope overload, SNR calculations, Comparison of PCM, DPCM ADPCM and DM, Adaptive digital wave form coding schemes, Non-waveform coding schemes- LPC, CELP, Video Coding, MPEG, JPEG Design of digital communication systems.

ECU 400: RESEARCH METHODOLOGY

Sources of published materials in engineering. Techniques of literature searching. Methods of information retrieval. Project idea generation. Project proposal writing. Data collection and analysis. Preparation of scientific and technical reports. Presentation of reports. Dissemination of research findings. Case study and reports based on anticipated final year project areas.

EEE 408: ENGINEERING PROJECT I

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of study.

EEE 412: POWER SYSTEMS III

Electric power Generation: Characteristics and efficiencies of hydro, thermal, gas ,diesel plants. Power generation economics. Load curves and maximum demands. Station operating

schedule. Plant capacity and plant use factors. Load growth forecasting. Design and lay-out of power Systems; Power circle diagram. Economics of power System design. conductor efficiency for various systems. Choice of system voltage. Kelvins Law. Load factor. Loss load factor. Lead-lag factor. Protection: Simple fault current calculations; symmetrical faults; principle of operation, characteristics and application off uses, electromagnetic and thermal over-current relays. Protection schemes; Distance protection; voltage and current transformers; circuit breakers, rating. Circuit interruption and switching over voltage; arc extinction and re-ignition, Resistance switching, switching surges. Chopping magnetizing current. Power System over-voltage: Sources of system over voltages; protection against atmospheric over-voltages corona usefulness: corona losses: ratio interference.

EEE 414: INSTRUMENTATION

Instrument systems: Intelligent vs dumb instruments, factors afecting system selection; linearity, accuracy, precision, resolution, sensitivity, hysteresis. Remote sensing techniques. Transducers: Passive and active types. Transducer selection. Transducer characteristics. Resistive, inductive, capacitive, and Hall-efect types. Applications of transducers in measuring de- vices. Signal Processing circuits: bridge circuits; instrumentation amplifiers, choppers and chopper-stabilized amplifiers, charge amplifiers, Voltage-to- frequency and frequency-to-voltage conversion. Analog-Digital and Digital- to-Analog conversion. Measurement systems: measurement of stress and strain; displacement; acceleration; temperature; humidity. Opto-electronic measurements. Measurement of Low Level Quantities: Noise sources. Efects of noise on small signals. Noise and interference reduction. Introduction to Digital Instrumentation: Principles and examples of digital instruments. Mi- croprocessor applications in instrumentation, RS-232 and IEEE-488 General Purpose Interface Bus (GPIB), digital data acquisition and storage.

ECU 402: ENGINEERING ECONOMICS

Origins of Engineering Economics, principles of engineering economics, engineering economics and the design process, accounting and engineering economic studies, theory of demand, supply and the concept of equilibrium, concept of elasticities of demand, theory of production and costs, cost- driven design optimization, perfect/ atomistic/ pure competition, monopoly, monopolistic competition, oligopoly, investments, MEC and MEI, money- time relationships and equivalence, application of money time relationships, comparing alternatives, basic theories of international trade, balance of payment, current and capital accounts, price changes and the exchange rates, depreciation concepts and terminologies, classical (Historical) depreciation methods, modified accelerated cost recovery system, introduction to income taxes, effective (marginal) corporate income tax rate, gain (loss)on the disposal of an asset, general procedure for making after tax economic analysis, an integrated approach to cost estimation, selected estimating techniques (models), parametric cost estimating, cost estimation in the design process, estimating cashflows for a typical small project, reasons for replacement analysis, factors that must be considered in replacement studies, determining the economic life of a new asset (challenger), determining the economic life of a defender, comparisons in Which the defender's useful life differs from that of the challenger, retirement without replacement (Abandonment), Risk, uncertainty and sensitivity, sources of uncertainity, sensitivity analysis, analyzing a proposed business venture, risk- adjusted minimum attractive rates of return, reduction of useful life, perspectives and terminologies for analyzing public projects, self-liquidating projects, multi- purpose projects, difficulties in evaluating public sector projects,

what interest rate should be used for public projects, the benefit cost ratio method, evaluating independent projects,

EEE 407: OPERATIONAL RESEARCH

Operational research: Introduction, scope and applications. Linear programming; graphical and algebraic solutions, simplex method, dual solution and interpretation, transportation. Sensitivity analysis; transportation algorithm, use of computer packages. Network Analysis: preparation of a network, location of the critical path time and resource scheduling, use of computer packages. Simulation model, simulation techniques, introduction to computer simulation. Inventory models: inventory control and computer. Decision theory: decision trees, expected value and utility. Game theory: maximum, maxmax and minimax criteria. Queuing theory related to maintenance. Minimax flow as related to network design.

EEE 415: ELECTRODYNAMICS & INSULATING MATERIALS

Revision of Maxwell's Equations:Maxwell's equations, Laplace equation, Poisson's equation, Helmholtz equation and their solution in rectangular, cylindrical and spherical co-ordinates. Retarded potentials. Numerical methods in boundary value problems. Propagation of Uniform Plane Waves:Propagation of uniform plane waves in uniform dielectric, reflection and refraction and refraction of waves at dielectric boundaries. Phase velocity, group velocity wavelength and wave number. Polarisation: linear, circular and elliptical. Introduction to propagation in anisotropic media. Transmission line analogue of wave propagation. The concept of wave impedance. Introduction to Diffraction and Scattering: Fresnel and Fraunhoffer diffraction, geometrical theory of diffraction, scattering. Insulating Materials:Classification of insulators on the basis of thermal stability. Types of insulators; solids, liquids, gases. Mechanical, thermal and electrical properties of insulating materials. Gaseous insulation: ionisation and breakdown in gases (Townsend breakdown). Factors influencing breakdown voltages. Guided electromagnetic Waves: Basic equations of waves along uniforms systems. Basic wave types TEM, TE, TM. Field analysis and distributed parameter analysis of transmission lines. Rectangular and cylindrical waveguides. Surface waveguides, optical fibres, dielectric slab wave guides. Power transmission and attenuation. Wave velocities. Introduction to Antennas: Concept of radiation, some elementary antennas. Antenna parameters, thin wire antenna, cylindrical dipole antenna, halfwave dipole antenna, antenna arrays. Effect of the earth and nearby objects. Introduction to Electromagnetic Compatibility: Concept of electromagnetic wave interference and noise. Calculation of near and far fields, electromagnetic radiation standards. Atmospheric electricity. Shielding and earthing. Insulating Materials: Solid insulation. thermal breakdown in solids, breakdown due to gradual deterioration. Effects of voids. Liquid insulation. Gases dissolved in mineral oils. Ageing and faults,

ECU 403: INDUSTRIAL PRACTICAL ATTACHMENT II (12 WEEKS)

This will be at the end of their fourth year of study and will involve relevant organizations and industries. The student will be attached to an organization and be a part of the work force. They will participate in all activities related to: Routine office work, field work, workshop work, and any other work as may be assigned by the field supervisor. The student will be required to complete 12 weeks of the attachment. The student will be required to maintain a log-book

which will be issued by the Centre for Career Development. This will be the basis of the assessment when the students reports back at the university.

3.5 Level 500

Power Engineering Option

ECU 500: ENGINEERING PRACTICE AND ETHICS

Engineering Ethics: Fundamental principles of engineering practice. Rules of practice. Professional obligations. Engineering Consultancy. The nature and sources of contract. The law of tort. Intellectual property laws. Contractual obligations. The Engineers Act. Engineers Professional Societies. The engineer as a consultant. The engineer as a contractor. Engineer in contractual disputes. The role of an engineer in society. The Occupational Safety and Health Act and conditions of work. ISO 9000. ISO 14001. ISO 18000. Industrial relations in Kenya. Trade unions, Collective bargaining, labour laws, arbitration and the industrial court. Kenya Bussiness Units: sole proprietorship, partnership, limited liability company, corporation, parastatal and cooperatives.

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of study.

EEE 501: RENEWABLE ENERGY TECHNOLOGIES

Introduction to renewable energy sources. Quantification of solar and wind energy sites. Photo-voltaic energy conversion. Maximum power point tracking. Principles of wind energy conversion (wind farms and maximum power point tracking). Modelling and simulation of photo-voltaic (PV) and wind energy generators. PV applications: grid connected and solar home systems. System sizing. Energy storage, batteries, fuel cells, flywheels, configuration and design. Micro-hydro systems and design principles. Grid interfacing of renewable energy systems. Hybrid systems for remote area power supplies. Solar water pumping. Economics of renewable energy systems. Case studies of renewable energy systems.

EEE 502: POWER SYSTEMS ANALYSIS

Fundamentals of Power System: Concepts of real and reactive powers, complex power, transmission capacity, load characteristics, per unit representation of power system.

Load Flow Analysis: Static load flow equations, network model formulation, solutions by Gauss-Siedal and Newton-Raphson method, effect of regulating transformers.

Power System Stability: Steady State Stability, transient stability, swing equation, equal area criterion for stability improvements of transient stability.

Economic Operation of Power System: Distribution of load between units within a plant, transmission loss as a function of plant generation, calculation of loss coefficients, distribution of load between plants, optimal scheduling of hydro thermal system.

Control Problem: Basic control of generator, small signal analysis, Automatic voltage regulator (AVR) exciter type and modeling generator modeling, static performance of AVR loop, Dynamic response of AVR loop, Automatic load frequency control, Turbine speed governing system and modeling, generator load model, block diagram representation of isolated power system, steady state analysis,' Dynamic response, proportional plus integral control.

EEE 504: POWER TRANSMISSION AND DISTRIBUTION

Review of Power T&D Equipment & Models: OH & UG line models; Characteristics of Conductors; Line loading Characteristics; Transformer Connections; Steady-State Performance Analysis of T&D Systems: System Modelling using network analysis; Three-phase power flow analysis; Voltage regulation & Reactive power compensation; Transmission & Distribution System Planning & Design: Review of generic planning methods; Load Evaluation and Demand Forecasting; Electrical Design of Lines and Substations; Mechanical Design of Lines and Substations; Economic and Environmental Considerations in T&D System Planning & Design

EEE 507: ENERGY MANAGEMENT AND ENVIRONMENTAL PROTECTION

This course offers a thorough introduction to methods for the evaluation of the environmental consequences of energy systems. Methods include human and ecological risk analysis and external cost analysis. Students learn how to evaluate environmental stresses and human health consequences of energy technologies. The course covers the use of toxicological and epidemiological data in risk assessment, assessment of chemical fate and exposure, and evaluation of climate change. Through a combination of these methods, students will be able to gain a comprehensive understanding of the environmental consequences of today's energy systems.

Telecommunication Option

ECU 500: ENGINEERING PRACTICE AND ETHICS

Engineering Ethics: Fundamental principles of engineering practice. Rules of practice. Professional obligations. Engineering Consultancy. The nature and sources of contract. The law of tort. Intellectual property laws. Contractual obligations. The Engineers Act. Engineers Professional Societies. The engineer as a consultant. The engineer as a contractor. Engineer in contractual disputes. The role of an engineer in society. The Occupational Safety and Health Act and conditions of work. ISO 9000. ISO 14001. ISO 18000. Industrial relations in Kenya. Trade unions, Collective bargaining, labour laws, arbitration and the industrial court. Kenya Bussiness Units: sole proprietorship, partnership, limited liability company, corporation, parastatal and cooperatives.

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented

with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of study.

EEE 501: RENEWABLE ENERGY TECHNOLOGIES

Introduction to renewable energy sources. Quantification of solar and wind energy sites. Photo-voltaic energy conversion. Maximum power point tracking. Principles of wind energy conversion (wind farms and maximum power point tracking). Modelling and simulation of photo-voltaic (PV) and wind energy generators. PV applications: grid connected and solar home systems. System sizing. Energy storage, batteries, fuel cells, flywheels, configuration and design. Micro-hydro systems and design principles. Grid interfacing of renewable energy systems. Hybrid systems for remote area power supplies. Solar water pumping. Economics of renewable energy systems. Case studies of renewable energy systems.

EEE 544: TELETRAFFIC ENGINEERING

Telephone and Telegraph systems: Wire telephony, public telephone network, the telephone loop, teleprinters and telegraphs. System structure: Basic transmission system. Types of switching: Circuit switching, message switching and packet. Network topologies, exclusive and multiparty lines. Signalling methods; (e.g. signalling No. 7 etc). Exchanges: Analogue, digital, stored program control exchanges, Private Automatic Branch Exchange (PABX). Call types: Local, trunk and international, automatic multi-exchange connection and exchange signalling. Terminal Equipment: Telephone set (receiver and transmitter), telex, facsimile, computer, etc. Digital communication network: Communication architecture, communication protocols, layer architecture in data network, packet switching networks, Integrated Services Digital Network (ISDN), Local Area Networks (LAN),Wide Area Networks (WAN), internet working, security. System design and planning: Basic traffic theory, queuing theory, grade of service, demand of service, traffic overload, performance of communication networks, reliability of service, economic analysis and planning, size and capacity.

EEE 509: MOBILE AND WIRELESS COMMUNICATIONS

Wireless Communication Fundamentals: Overview of wireless communication systems, The wireless channel, Wireless transmission, loss mechanisms in the wireless channel: Attenuation, Scattering, Diffraction, Polarization, Fading, Inter-Symbol Interference, Multipath propagation, Noise. Mobile Networks and Their Evolution: Introduction to the wireless technology generations: 1G, 2G, 2.5G, 3G, 3.5G, 4G, Universal Mobile Telecommunications Service (UMTS), Standardization and convergence. Cellular Concepts: Cellular concept, macro-cell, micro-cell, pico-cell, frequency reuse, sectoring, channel assignment, handover strategies, Interference and system capacity, Trunking and Erlang capacity, Quality of service, Improving coverage and capacity in cellular systems. Cell Planning Basics: Capacity and coverage analysis, Preliminary design: site surveys, equipment, system growth and changes. Radio Propagation Models and their application in cell planning. Traffic Theory and its application in cell planning. Radio link power

budget and path losses. Frequency planning: Frequency Reuse, Cell Splitting, Sectoring techniques, Radio resource provisioning: traffic channels, control channels Multiple Access Systems: Wireless Data Networks: Wireless Local Area Networks: design of personal wireless systems. IEEE 802.11: Overview. Radio Specifi- cations. Baseband Specification. Link Manager Specification. Logical Link Control and Adaptation Protocol. IEEE 802.11(WiFi), IEEE 802.16(WiMAX/WirelessMAN), Wireless Wide Area Networks: Global System Mobile Communications (GSM), Code Division Multiple Access (CDMA), General Packet Radio Service (GPRS), Enhanced Data for GSM Environment (EDGE), High- Speed Downlink Packet Access (HSDPA) Design of wireless communication systems

EEE 545: SATELLITE COMMUNICATION

Orbital Aspects: Kepler law-orbit fundamentals-orbit shape-satellite speed and period-angle of indication-station keeping-attitude control-orbital elements-orbital pertubation-SSP-satellite launching –transfer orbit-antenna look angles-LEO, MEO, GEO-Sun synchronous orbit - constellation Link Design: Frequency of operation-bands-propagation effects on the signal-attenuation, frequency rotation, ice and snow effects –depolarization-sun transit outage-eclipse-EIRP-Power budget equation-Uplink power-Downlink power-C\No,G\T-t system noise-thermal noise-intermodulation noise Space and Earth Segment: Space craft subsystem-power-attitude control-telemetry tracking and command-transponder-stabilization subsystem-thermal protection-payload-bus- antenna subsystem-earth segment-low noise amplifiers-high power transmitters-TWTA, Klystron amplifiers-redundancy configuration-Cassegrain antenna Satellite Services: Satellite bandwidth-frequency division multiplexing-time division multiplexing-multiple access-FDMA, TDMA, CDMA-INSAT INMARSAT, INTELSAT, weather forecasting, mobile satellite service, satellite navigation

Computer Engineering Option

ECU 500: ENGINEERING PRACTICE AND ETHICS

Engineering Ethics: Fundamental principles of engineering practice. Rules of practice. Professional obligations. Engineering Consultancy. The nature and sources of contract. The law of tort. Intellectual property laws. Contractual obligations. The Engineers Act. Engineers Professional Societies. The engineer as a consultant. The engineer as a contractor. Engineer in contractual disputes. The role of an engineer in society. The Occupational Safety and Health Act and conditions of work. ISO 9000. ISO 14001. ISO 18000. Industrial relations in Kenya. Trade unions, Collective bargaining, labour laws, arbitration and the industrial court. Kenya Bussiness Units: sole proprietorship, partnership, limited liability company, corporation, parastatal and cooperatives.

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of

study.

EEE 501: RENEWABLE ENERGY TECHNOLOGIES

Introduction to renewable energy sources. Quantification of solar and wind energy sites. Photo-voltaic energy conversion. Maximum power point tracking. Principles of wind energy conversion (wind farms and maximum power point tracking). Modelling and simulation of photo-voltaic (PV) and wind energy generators. PV applications: grid connected and solar home systems. System sizing. Energy storage, batteries, fuel cells, flywheels, configuration and design. Micro-hydro systems and design principles. Grid interfacing of renewable energy systems. Hybrid systems for remote area power supplies. Solar water pumping. Economics of renewable energy systems. Case studies of renewable energy systems.

EEE 522: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Human and machine intelligence, developing an AI, expert system definition, natural language processing, tools for machine thinking, forward chairing, backward chairing, use of portability and fuzzy logic in expert systems, knowledge plan interim, examples of expert systems, programming techniques.

EEE 509: MOBILE AND WIRELESS COMMUNICATIONS

Wireless Communication Fundamentals: Overview of wireless communication systems, The wireless channel, Wireless transmission, loss mechanisms in the wireless channel: Attenuation, Scattering, Diffraction, Polarization, Fading, Inter-Symbol Interference, Multipath propagation, Noise. Mobile Networks and Their Evolution: Introduction to the wireless technology generations: 1G, 2G, 2.5G, 3G, 3.5G, 4G, Universal Mobile Telecommunications Service (UMTS), Standardization and convergence. Cellular Concepts: Cellular concept, macro-cell, micro-cell, pico-cell, frequency reuse, sectoring, channel assignment, handover strategies, Interference and system capacity, Trunking and Erlang capacity, Quality of service, Improving coverage and capacity in cellular systems. Cell Planning Basics: Capacity and coverage analysis, Preliminary design: site surveys, equipment, system growth and changes. Radio Propagation Models and their application in cell planning. Traffic Theory and its application in cell planning. Radio link power budget and path losses. Frequency planning: Frequency Reuse, Cell Splitting, Sectoring techniques, Radio resource provisioning: traffic channels, control channels Multiple Access Systems: Wireless Data Networks: Wireless Local Area Networks: design of personal wireless systems. IEEE 802.11: Overview. Radio Specifi- cations. Baseband Specification. Link Manager Specification. Logical Link Control and Adaptation Protocol. IEEE 802.11(WiFi), IEEE 802.16(WiMAX/WirelessMAN), Wireless Wide Area Networks: Global System Mobile Communications (GSM), Code Division Multiple Access (CDMA), General Packet Radio Service (GPRS), Enhanced Data for GSM Environment (EDGE), High- Speed Downlink Packet Access (HSDPA) Design of wireless communication systems

EEE 554: COMPUTER NETWORKS

Introduction to Network concepts, types of networks; topologies. Combinational networks, Local Area Networks; wireless network communications, protocols, architecture, operations, standards & specifications, data links, and transport layers, administration & support;

troubleshooting. Synchronous and asynchronous digital communication networks: the characteristics, standards, performance and optimisation of design. Networking devices, operating systems and applications.

Power Engineering Option

EEE 505: SWITCHGEAR AND PROTECTION

Review of fault analysis for circuit breaker & protective relay application. The fault clearing processes: problem of switching, arcing and arc-interruption principles. Recovery and re-striking voltages. Classification, construction and characteristics of circuit breakers & associated switchgear: Oil circuit breakers, magnetic air circuit breakers, air-blast circuit breakers, water circuit breakers, etc. Testing, rating & maintenance of circuit breakers. Classification, construction and characteristics of protective relays: over-voltage, under-voltage, over-current, directional, differential, distance relays both electromagnetic and solid state. Protection of major power system & consumer equipment and components: Line (both untapped or two-terminal lines and tapped or multiple-terminal lines with a single source or two sources) protection, generator protection, transformer protection, bus protection, electrical motor protection, protection of special electrical installations (capacitor banks, automatic voltage regulators, electroheat transformers, converters)

EEE 503: INDUSTRIAL MANAGEMENT

Microeconomics: theories of supply and demand; factors of production; economics of scale. Macroeconomics: input and output analysis; development economics; costbenefit analysis approaches to project evaluation and appraisal. Risk and uncertainty analysis. Systems analysis. Theories of management. Components of management: planning, organizing, stafng, controlling/coordinating and budget and budgeting analysis. Planning industrial setup; capacity planning, resource allocation and scheduling. Forecasting techniques: replacement models, queuing theory, transport and simulation models, game theory.

EEE 506: HIGH VOLTAGE TECHNOLOGY AND HVDC TRANSMISSION

Breakdown mechanism in gases, solids, liquids. Dielectrics: properties, effects of temperature, frequency, pressure, humidity and voltage. Ionisation process and decay. Flashover. Characteristics of liquid and plastic dielectrics. Corona: voltages, characteristics, gradient discharges and corona power loss. Generation of high voltages: transformer over-voltages, behaviour and distribution, oscillations and surges. Alternator under-voltage surges. Overhead lines: surges, wave propagation, terminations and surge energy. Lightning and surge protection: shielding, resistance, surge diverters, horn-gaps, arresters and surge modifiers. Measurement of high voltages: sphere gaps, cathode ray oscilloscope, rectifier condenser-current peak voltmeter, potential dividers and tesla coil. High voltage testing equipment: transformers, direct current testing equipment and impulse generator. Non-destructive insulation test techniques. HVDC transmission: HVDC converters, advantages and economic considerations, converter control characteristics, analysis of HVDC link performance, Multi-terminal DC system, HVDC and FACTS

EEE 508: POWER ELECTRONICS AND VARIABLE SPEED DRIVES

DC Machines Drives: DC machine drive dynamics and performance equation, DC machine drive systems. Electronic control of DC drives using rectifier and choppers. Two and four quadrant control for DC machine drives. Transfer function of DC machine drive systems. Speed and current feedback control systems for DC machines drives. Microprocessor control systems for DC machine drives. Application of DC machine variable speed drives in traction including railway traction, lifts etc. AC Machine drive dynamics and performance equation. AC machine drive systems, induction motor drives. Synchronous motor drives. Electronic control of AC drives using inverters. Harmonic distortion and losses. Control of frequency, voltage and power. Transfer functions of AC machine drive systems with speed, current, flux feedback. Microprocessor control of AC machine drives. Applications of AC machine variable speed drives.

EEE 552: POWER SYSTEMS DYNAMICS AND CONTROL

Economic load dispatch: system constraints; selection of generators, voltage, running spare capacity, transformer tap settings and transmission line. Network security and merit order scheduling. Dispatch neglecting losses: optimum dispatch, physical integration of co-ordination equations for transmission networks. Exact transmission loss formula; modified co-ordination equations, automatic load dispatch using digital computer. Voltage control: generator voltage, voltage control by reactive power insertion, controlling through power flow by means of magnitude and phase-changing transformers. Frequency control: tie-line loading frequency characteristics, speed governing system.

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of study.

Telecommunication Option

EEE 512: DIGITAL SIGNAL PROCESSING

Sampling theory, Z-transforms, system functions. Digital filter structures, signal flow graphs, elementary FIR/IIR filter design techniques, windows, bilinear and band transformations. Discrete Fourier transform, relation- ship between DFT and DTFT, simple and short-time spectral estimation, fast computation of DFT as decimation-in-time. Linear convolution, cyclic convolution, sectioned convolution (overlap-add and overlap-save), application to fast filtering algorithms, windowing. Overview of microprocessor architectures for DSP, implementational aspects of simple DSP algorithms.

EEE 546: INFORMATION THEORY AND CODING

Review of probability theory: Sample space, Conditional probability, probability distributions, probability distribution functions, stochastic processes, statistical averages. Random variable and random process-covariance, Ergodic process, Markov process Source Coding: Mathematical model for information sources, Average mutual Information, Entropy in discrete and continuous cases, definition and properties of entropy, Joint and conditional entropy. The problem of unique decipherable code, instantaneous code, Kraft McMillan inequality. Discrete and Analogue Coding: Hufmanns Coding Algorithm, Discrete stationery sources, The Lempel Ziv algorithm, Optimum Quantization Rate, distortion function for memoryless Gaussian source. Upper bound of scalar quantization, vector quantisation, Linear predictive coding. Channel Coding: Channel models, Binary symmetric channel, Discrete memoryless channel, Discrete input contentious output channel, Channel capacity, Shannon fundamental theorem, Shannon Hartley theorem and its implications. Achieving channel capacity with orthogonal signals, channel reliability functions. Block and Convolution Codes: Linear block codes, Hadamard code, Golay code, Cyclic code, encoders, BCH code. Error detection and correction capability, convolutional codes, convolutional encoder, Viterbi algorithm.

EEE 529: FIBER-OPTIC COMMUNICATION

Introduction to Optical Fibers: Evolution of fiber optic system, Elements of an Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Wave guides, Overview of Modes- Key Modal concepts, Linearly Polarized Modes, Single Mode Fibers, Graded Index fiber structure. Signal Degradation in Optical Fibers: Attenuation, Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Wave guides, Information Capacity determination, Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in Single Mode (SM) fibers, Polarization Mode dispersion, Inter- modal dispersion, Pulse Broadening in GI fibers, Mode Coupling, Design Optimization of SM fibers, Refractive Index (RI) profile and cut-of wavelength. Optical Fiber Sources and Coupling: Direct and indirect Band gap materials, LED structure, Light source materials, Quantum efficiency and LED power, Modulation of a LED, lasers Diodes, Modes and Threshold condition, Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Fiber-to-Fiber joints, Fiber splicing. Optical Fiber Receivers: PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit. Optical Fiber Communication System: Point-to-Point links: System considerations, Link Power budget, Rise-time budget, Noise Effects on System Performance. Optical transmission formats and protocols: WDM, DWDM, SDH, SONET

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction,

measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fifth year of study.

EEE 547: MICROWAVE ENGINEERING

Microwave Passive Devices: Microwave waveguides, Rectangular and circular; Microwave cavities(resonators); Microwave components: directional couplers, circulators, isolators, striplines (micro, parallel, coplanar, shielded striplines), losses and mode analysis, transmission line equivalent, Scattering matrix and s parameters Techniques for dielectric and boundary perturbations, Slow wave guides and periodic cct Microwave Active Devices: Microwave transistors, tunnels, and FETs; Transferred electron devices (TED); avalanche transient devices (ATD); microwave generation and amplification; microwave linear beam tubes (MLBT); and microwave crossed-field tubes (MCFT) Microwave Communication Systems: Microwave communication systems: transmitters, receivers, and wireless links; Effects of biological exposure to microwave radiation

EEE 548: ANTENNA AND PROPAGATION

Antennas theory: Antenna parameters, radiation from a current loop and from a half-wave dipole. Antenna arrays: Pattern multiplication, array factor, broad-side and end-fire arrays. Feed networks: a quarter wave section, parasitic and log-periodic. Long-wire antennas: Radiation from a long-wire antenna with a travelling wave current. Construction designs: Vertical, inverted-Land T- aerials, the dipole and ferrite rod aerial. Aperture type antennas: horn, reflector, and their performance. Propagation: Properties of radio spectrum. Wave propagation: Solutions of wave equations in various media, reflection, refraction, diffraction and scattering. Types of scatter: atmospheric ducts, and radio link; diffraction and attenuation (Bullington curves, Epstein and Peterson curves, Deygout curves). Signal-to-noise ratio. Diversity techniques: Space and frequency.

Computer Engineering Option

EEE 512: DIGITAL SIGNAL PROCESSING

Sampling theory, Z-transforms, system functions. Digital filter structures, signal flow graphs, elementary FIR/IIR filter design techniques, windows, bilinear and band transformations. Discrete Fourier transform, relation- ship between DFT and DTFT, simple and short-time spectral estimation, fast computation of DFT as decimation-in-time. Linear convolution, cyclic convolution, sectioned convolution (overlap-add and overlap-save), application to fast filtering algorithms, windowing. Overview of microprocessor architectures for DSP, implementational aspects of simple DSP algorithms.

EEE 546: INFORMATION THEORY AND CODING

Review of probability theory: Sample space, Conditional probability, probability distributions, probability distribution functions, stochastic processes, statistical averages. Random variable and random process-covariance, Ergodic process, Markov process Source Coding: Mathematical model for information sources, Average mutual Information, Entropy in discrete and continuous cases, definition and properties of entropy, Joint and conditional

entropy. The problem of unique decipherable code, instantaneous code, Kraft McMillan inequality. Discrete and Analogue Coding: Hufmanns Coding Algorithm, Discrete stationery sources, The Lempel Ziv algorithm, Optimum Quantization Rate, distortion function for memoryless Gaussian source. Upper bound of scalar quantization, vector quantisation, Linear predictive coding. Channel Coding: Channel models, Binary symmetric channel, Discrete memoryless channel, Discrete input contentious output channel, Channel capacity, Shannon fundamental theorem, Shannon Hartley theorem and its implications. Achieving channel capacity with orthogonal signals, channel reliability functions. Block and Convolution Codes: Linear block codes, Hadamard code, Golay code, Cyclic code, encoders, BCH code. Error detection and correction capability, convolutional codes, convolutional encoder, Viterbi algorithm.

EEE 531: CRYPTOGRAPHY AND NETWORK SECURITY

Protocol layers and security protocols, intranets and extranets, security architectures. Cryptographic security protocols. Threats, attacks and vulnerabilities. Security services: Confidentiality, authencitation; integrity; Access control; and availability. Security mechanisms: encryption; data integrity mechanisms; digital signatures; keyed hashes; access control mechanisms. Principles of e-commerce. Distributed and embedded firewalls. Security zones.

EEE 557: NEURAL NETWORKS

Biology neural systems vs. convention serial computers. Pattern recognition theory and decision-making. Artificial neural networks: Perceptions, multi-layer perceptions and back propagation. Hopfied and Hamming networks, self-organizing techniques, Kohomnen networks. Adaptive system: Adaptive resonance theory, Boltzmann machines. Simulated annealing. Genetic algorithms. Hardware realizations. Neural network applications

Knowledge and skill required to provide assurance for information systems for managing business risks. Data Integrity. Security policy and user education. Concepts and methods for planning, designing, implementing,managing, and auditing security at all levels and platforms. Risk assessment associated with accidental and intentional breaches of security. Concurrent and continuous auditing of applications, auditing of system development, access control as a function of system design. Policy and technical issues. Cryptography.

EEE 500: ENGINEERING PROJECT II

Each student will be required to undertake a simple practical project involving specification, review, analysis, design, development and research. The student is presented with a real world engineering problem, and the solution to the problem must demonstrate a rigorous scientific approach, i.e. problem definition, analysis, design, construction, measurement, evaluation and communication. Students are expected to work largely on their own initiative. The duration of each project is two semesters in the fourth year of study.

EEE 555: COMPUTER GRAPHICS AND MULTIMEDIA APPLICATIONS

Computer graphics algorithms and programming windows, viewpoints, modeling, transformations in two and three dimensions, viewing transformation and hidden surface elimination. Graphics standards for hardware and software systems. Basic principles for the

design, use and understanding of interactive computer graphics system, specific input and output hardware devices and their technology, the software tabulars and programming methods for the design of a graphics package, and a survey of graphical applications as an effective means for communication. A large component of the class is the writing of a large scale program in a high level language that drives the output device, creates the models, manipulates the model or segments of the model, receives interactive input requests. Elements, principles and application of graphic design; page layout and design .Elementary colour theory & production techniques and current software applications. Applications of multimedia including DVD technology in technical and professional communication, education, marketing, and training, including authority for web pages. Hypermedia, hyperlinks, and interactive design for use in technical manuals, proposals, information kiosks, marketing presentations, resumes, and electronic information systems.

EEE 527: INTERNET APPLICATION PROGRAMMING

Scripting: CGI scripts, JavaScript, JAVA and applets. Use of a scripting language for animation, images and sound. Advanced features of Internet based programming language. Managing events and creating user interfaces and their application in Internet. Creating dynamic client server systems using tools such as JSP, JAVA servlets. Management of resources and users, Performance monitoring.

EEE 514: WEB DESIGN AND ELECTRONIC COMMERCE

Internet concepts, browsers, creating web pages & forms, adding client-side scripts & active elements, using dynamic HTML, database access, creating hyperlinks. E-commerce concepts, building sites, creating product catalogues, managing shopping carts. Using dynamic HTML, database, creating hyperlinks. Processing orders, checking out the purchase process, tracking shopper information, business to business commerce.

EEE 515: ANALOGUE FILTERS

Survey of electrical filter technology. Approximation theory, ideal response, least squares method. Butterworth-Chebychev inverse Chebychev, elliptic phase response. Thompson and Gaussian approximation. Passive filters. Outline of image parameter synthesis, exact one port and two port synthesis of LC and RC network, ladder development with terminations, duality, transformations, pre-distortion, denormalisation. Active filters: controlled sources operational amplifier and converter.

EEE 516: STATE SPACE DESIGN AND DIGITAL CONTROL

State Space Design: review of the state space system description. Controller design. Selection of pole locations for good design. Estimator design. Compensator design and introduction of the reference input. Integral control design for systems with pure time delay. A design case study to illustrate state space design using suitable software. Digital control: Sampled data systems and the z-transform, inverse z-transform. Difference equations and pulse transfer functions. Mapping between the s-plane and the z-plane. Stability analysis. Impulse sampling and Data holds (Zero-Order Hold, First- Order-Hold, etc). Reconstruction of signals from sampled signals - Shannons theorem, properties of the ideal low-pass filter, frequency response of the Zero-Order-Hold. Block-diagram analysis

- open-loop and closed-loop systems. Controller design: direct and indirect design methods. Implementation of discrete-time controllers using microprocessors, digital signal processors and microcontrollers. A design case study to illustrate discrete-time controller design and implementation. State-space analysis for discrete-time systems.

EEE 517: ANALOGUE ELECTRONICS DESIGN

Design and Fabrication of Op-amps: Integrated Circuits fabrication - limitations. Integrated Circuit op amps: conventional, Norton, and trans-conductance types. Working principles. Electronic Circuit Designs: Design of circuit systems such as waveform generators, precision rectifier systems, automatic gain amplifiers, four quadrant multipliers. Chopper stabilized opamp and its applications in instrumentation systems. Integrated Circuit Systems: Integrated Circuit instrumentation amplifiers: working principles. Design of bridge and thermocouple amplifiers. Integrated Circuit waveform generators: principle of operation. Design of function generators and frequency modulators. Audio pre- and power amplifier Integrated Circuits. Design of audio systems. Phase-locked loop Integrated Circuits: Principle of operation, use in frequency multiplication, phase shifting, tone and telemetry decoding, frequency packing and pulse generation. Design examples.

EEE 518: DIGITAL IMAGE PROCESSING

Two dimension linear space invariant systems. 2-Dimension Z-Transform and 2-Dimension DFT. Image restoration: Degradation model, algebraic approach, inverse filtering, Wiener (LMS) filter, restoration in spatial domain, geometric transformations. Image Compression: Compression models, error-free compression, loss compression, image compression standards. Image segmentation: Detection of discontinuations, edge linking and boundary detection thresholding, region-oriented segmentation, use of motion in segmentation. Representation and description: Representation schemes Boundary descriptions: Regional descriptors, morphology, relational descriptors. Recognition and Interpretation: Elements of Image analysis, patterns and pattern classes, Decision theoretic methods, structural methods, interpretation.

EEE 520: REAL TIME SYSTEMS

Theory and operation of real-time applications, acquisition, compression, storage retrieval and presentation of data from different media types such as images, text, voice and alphanumerical; real time embedded computer systems, software reliability and reliability modelling reliable system.

EEE 521: DECISION SUPPORT SYSTEMS

Decision making, information theory, knowledge representation and knowledge systems, retrieval concepts and languages, decision support systems and development methodologies.

EEE 523: NONLINEAR AND MULTIVARIABLE CONTROL

Non-linear Control: Non-linear behaviour and describing function. Stability analysing describing fuctions, second, or direct, method of Lyapunov; Popov and circle criterial for stability. The phase-plane method. Introduction to optimal control, model-reference, and

adaptive control strategies and their implementations. Multivariable feedback systems in the frequency domain: Introduction: generalization and extension of Single-Input/ single - Output to Multiple-/Multiple-Output Systems. Extension of the Nyquist Stability theorem to MIMO Systems; direct and inverse Nyquist plots. Direct and inverse Nyquist Array methods, The characteristic locus methods. Computer aided analysis and design of a multivariable systems is illustrated with a case design example using suitable control engineering software.

EEE 524: ADVANCED OBJECT ORIENTED PROGRAMMING

The concept of object-oriented (OO) user interfaces (UI), analysis for the UI, iterative steps of usability engineering to build, test, and refine multiple small-scale UI prototypes. Applications of OO analysis, software engineering, usability engineering techniques in systems development. Usability, quality, measurement, planning and management factors of software engineering.

EEE526: ELECTRONIC COMPUTER AIDED DESIGN AND MANUFACTURING TECHNIQUES

Computer aided design (CAD): Modelling of circuits and systems, modular simulation, gate array testing, one-off production techniques, interactive 3-D graphics design. Computer Aided Manufacturing (CAM): machine automation, process control, part inspection, automatic quality control. Manufacturing techniques: VLSI device level fabrication techniques, chemical and laser etching. Board level construction techniques; solder reflow, surface mount and mass production, packaging and testing.

EEE 513: DISTRIBUTED SYSTEMS

The characteristics and objectives of distributed systems. Separation of logical design from implementation. Impact on the design of high level languages. Distribution of data, management, control; maintenance and administration. Network support requirements. Network owners vs. network users. Processors and processes. Process communication and resource sharing. Communication primitives. Application oriented services; Virtual processors, virtual file service, virtual terminal service, job transfer, their design and implementation. Operating systems and programming languages for concurrent and distributed systems.

EEE 556: PROGRAMMABLE LOGIC CONTROLLERS

Review of control systems. Overview of programmable logic controllers, input/output modules, signal conditioning and wiring. PLC programming using ladder diagrams, functional block diagrams, statement lists, sequential function charts or structured programming, IEC 1131-3 programming. . Supervisory Control and Data Acquisition. PID control modules. Communications and automation. Application of PLCs in areas such as robotics, flexible manufacturing systems, batch and continuous processes and production monitoring. Practicals with a PLCs such as the Mitsubishi, Siemens or Allen-Bradley series.

EEE 529: FIBER-OPTIC COMMUNICATION

Introduction to Optical Fibers: Evolution of fiber optic system, Elements of an Optical Fiber Transmission link, Ray Optics, Optical Fiber Modes and Configurations, Mode theory of Circular Wave guides, Overview of Modes- Key Modal concepts, Linearly Polarized Modes, Single Mode Fibers, Graded Index fiber structure. Signal Degradation in Optical Fibers: Attenuation, Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses,

Signal Distortion in Optical Wave guides, Information Capacity determination, Group Delay-Material Dispersion, Wave guide Dispersion, Signal distortion in Single Mode (SM) fibers, Polarization Mode dispersion, Inter- modal dispersion, Pulse Broadening in GI fibers, Mode Coupling, Design Optimization of SM fibers, Refractive Index (RI) profile and cut-of wavelength. Optical Fiber Sources and Coupling: Direct and indirect Band gap materials, LED structure, Light source materials, Quantum efficiency and LED power, Modulation of a LED, lasers Diodes, Modes and Threshold condition, Rate equations, External Quantum efficiency, Resonant frequencies, Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers, Power Launching and coupling, Fiber-to-Fiber joints, Fiber splicing. Optical Fiber Receivers: PIN and APD diodes, Photo detector noise, SNR, Detector Response time, Avalanche Multiplication Noise, Comparison of Photo detectors, Fundamental Receiver Operation, preamplifiers, Error Sources, Receiver Configuration, Probability of Error, Quantum Limit. Optical Fiber Communication System: Point-to-Point links: System considerations, Link Power budget, Rise-time budget, Noise Effects on System Performance. Optical transmission formats and protocols: WDM, DWDM, SDH, SONET

EEE 530: VIRTUAL REALITY MODELLING SYSTEMS

Integration of real and virtual objects, creation of the effect of computer generated three-dimensional environments, spatial presence of virtual objects, and technologies of immersion. Multimedia, multimode al and virtual reality interaction.

EEE 532: HUMAN COMPUTER INTERACTION

Effectiveness of human interaction with computers presentation of cognitive and perceptiful issues, human information processing, user concerns and interaction systems. Strategies addressing the ease of learning and use of software systems. Projects in cognitive ergonomicc, human factors in software development.

EEE 534: POWER SYSTEM ECONOMICS AND PLANNING

Basic Concepts from Economics (incl. utility financial accounting; time value of money; utility economic evaluation methods; financial & regulatory analysis); Generic planning & design issues: Overview of power system planning issues (incl. interchange capability, interconnections, pooling, etc.). Overview of mathematical tools for power system planning & design. Load forecasting methodologies & techniques. Load classification & characterisation. Energy & peak-demand forecasting. Power Generation Economics (both operation and investment economics): Economic generator size & site selection. Concept of reserves. Unit commitment and applications of dynamic programming, fuel budgeting and planning, probabilistic cost modelling, hydrothermal co-ordination, power system security, state estimation. Power Transmission & Distribution Economics (both operation and investment economics): Types of electrical energy supply networks and their characterisation. Outline of electrical energy network planning & design: Planning objectives, stages in planning & design. National & International standards. Aspects of planning & design of electrical energy supply networks (utility, industrial, commercial, residential buildings): Regulatory issues, switchboard design & operation, cable sizing, network configuration design, reliability analysis & consideration in network planning & design, earthing & electrical safety issues, power quality considerations, voltage control & reactive power compensation, cost considerations. Economics of system interconnection or integration. Power system maintenance economics & planning.

EEE 535: ILLUMINATION ENGINEERING

Fundamentals: electromagnetic radiation, radiant energy and light propagation. Colour. Measurements. Quantum electronics: excitation, ionisation, radiation, energy levels and spectra of lighting elements. Discharge: Town-send, glow and arc. Lamps: materials: glasses, ceramics, metals, seals, gases and phosphorus. Incandescent: construction, manufacturing techniques, quality and safety controls and environmental testing. Special lamps. Fluorescent, mercury, and sodium lamps: design, construction, manufacture, performance and application. Electro-luminescence: electro-luminescent panels, light emitting films, and light emitting diodes. Optical detectors, photo detectors, and optical displays. Luminnaires and Circuits: electrical and electronic circuits. Electrical characteristics of lamps, ballast, fluorescent and discharge lamps' circuits. Luminaries design and manufacture, design objectives, materials, production processes, specifications and testing. Interior Lighting: lighting objectives and criteria, design decisions, design calculations and equipment ratings. Aesthetic designs, cost optimization. Use of computers for interior lighting design.

EEE 536: OPTIMIZATION AND CONTROL

Review of control theory. Linear/non-linear programming. Quadratic optimal control, Dynamic programming and the Hamilton-Jacobian-Bellman (HJB) equation. Calculus of variations. Hamiltonian and costate equations. Pontryagin's maximum principle. Kalman filters, Solution to common constrained optimization problems.

EEE 538: ELECTRICAL MACHINE DESIGN

Windings: Conductors, insulators, eddy currents, slot conductors, overhang conductors, transformer coils; permeable and conducting masses; electromotive force; transformer windings; D.C. field windings, a.c. armature windings: single layer windings; Double -layer windings; Fractional - slot windings; Types of double - layer winding; choice of winding, e.m.f. of windings, harmonics, magnetomotive force of windings. Transformers: Design Frames, thermal rating, momentary load limitations, output equation, specific iron and copper losses, insulation. Types of windings and connections. Cooling and ratings Iron core dimensions. Rotating Machine Design: Output equation; specific copper and iron losses: power/weight ratio, salient pole and cylindrical rotor. Air gap flux distribution and saturation; Insulation, heating; ventilation and ratings. Computer-Aided Electrical Machine Design.

EEE 539: ELECTRICAL POWER GENERATION

Review of Energy Sources. Types/Classification of Power Plants: (incl. Conversion Principles). Construction, Operation, and Application of Major Equipment Installed and Layouts/Configurations of Different Types of Power Stations. Economic Operation of Power Plants: Cost Characteristics of Power Plants, Economic Generating Unit Commitment & Dispatch Problems. Environmental Performance of Power Plants and Mitigation against Environmental Effects. Power Plant Planning & Design: Economic Evaluation of Power Plant Projects

EEE 540: FUZZY LOGIC AND NEURAL NETWORKS

Fuzzy Set Theory and Fuzzy Logic Fuzzy Logic Control Learning paradigms, perceptron learning Multi-Layer Perceptron and Back-propagation learning Pattern classification Support vector machines Clustering, Self-Organization Map Radial Basis Network, Time series analysis, system identification and expert system applications Genetic Algorithm and Evolution Computing Recurrent Network, Hopfield network Applications in Control Systems, Power Systems.

EEE 541: UTILIZATION OF ELECTRICAL ENERGY

Characteristics of Electrical Energy & its Usage:. Types, Construction, Operation, and Application. Energy Utilizing Devices, Technologies & Processes: Electric Drives; Illumination; Electric Heating; Electric Welding; Electrolytic Processes; Refrigeration and Air Conditioning; Electric Traction. Electric Energy Demand Evaluation & Forecasting. Demand-Side Management (DSM): DSM Objectives, Activities, and Application. Economic Aspects of Energy Utilization: Electricity pricing and tariff design

EEE 542: SAFETY ENGINEERING

Health hazards: Vibration and noise; magnetic fields; toxic substances and properties: Liquids, dusts, and gases; Explosives, Classifications; Public Health and Occupational Diseases. Industrial Engineering systems failures: Types of failure; emergency action plans; transportation, storage and handling of hazardous materials. Prevention of Accidents: Promoting safe behavior; workers compensation for risky working environments. Safety engineering, risk management and assessment principles; quality assurance in occupational health services; cost-risk-benefit analysis Occupational health and safety regulations.

EEE 553: RADIO COMMUNICATION ENGINEERING

Radio wave propagation: Surface waves, space waves, and sky wave propagation, ionospheric effects; atmospheric effects on waves; fading and effects on communication; diversity techniques; scatter propagation, reflection of radio waves. *Propagation losses in communication links:* path loss, multipath fading, diffraction losses, scattering losses, shadowing. *Transmitters and Receivers:* Types of transmitters and receivers used in radio communication and their characteristics.*Broadcast and point to point communication:* Radio broadcasting, Studio links, outside broadcasting, broadcasting system specifications and design. Trunked systems.

EEE 522: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Human and machine intelligence, developing an AI, expert system definition, natural language processing, tools for machine thinking, forward chairing, backward chairing, use of portability and fuzzy logic in expert systems, knowledge plan interim, examples of expert systems, programming techniques.

EEE 512: DIGITAL SIGNAL PROCESSING

Sampling theory, Z-transforms, system functions. Digital filter structures, signal flow graphs, elementary FIR/IIR filter design techniques, windows, bilinear and band transformations. Discrete Fourier transform, relation- ship between DFT and DTFT, simple and short-time spectral estimation, fast computation of DFT as decimation-in-time. Linear convolution,

cyclic convolution, sectioned convolution (overlap-add and overlap-save), application to fast filtering algorithms, windowing. Overview of microprocessor architectures for DSP, implementational aspects of simple DSP algorithms.

EEE 510: SIMULATION & MODELING

Introduction to Performance Modelling, The Essentials of Probability. Simulation Modelling: Random number generation and Monte Carlo Methods, Discrete event simulation, Output analysis. Discrete Event Stochastic Models: Elementary Stochastic Point Processes, -Arrival Processes (Poisson Process). Markov Models: Synchronous Processes: Discrete-time Markov Chains Asynchronous Processes: Continuous-time Markov Chains. . Queuing Models/Synchronous and Asynchronous Queues:Little's law, Single Server Queues, Multiple Server Queues, Priority Queues, Queues with Loss, M/G, G/M, G/G Queues, Networks of Queues, Network Modelling. Reliability Modeling. Application of simulation software such as SimScript, GPSS to implement a project.

EEE 550: DISTRIBUTED OBJECTS

Introduction to distributed objects, Principles of Object-Oriented Middleware, CORBA, COM and Java/RMI, Resolving Heterogeneity Dynamic Object Requests, Communication between Distributed Objects, Locating Distributed Objects, Trading Service and Naming Service, Advanced Features, Event Services, Notification Services, Persistent Services, Transaction Services, Security

EEE 537: EMBEDDED SYSTEMS DESIGN

Definition, structure and properties of embedded systems. Real-time programming: interrupts, latency, context, re-entrancy, thread and process models. Microcontroller and DSP architectures, I/O systems, timing and event management. Real-time kernels and services. Techniques for development, debugging and verification. Techniques for limited resource environments. Networking for distributed systems.

EEE 519: RADIO FREQUENCY CIRCUIT DESIGN

Modelling of RF Devices:Behaviour of passive components at high frequencies (frequencies up to 3 MHz are used in this course). Modelling of RF circuits: Q, and h- y- and S-parameters. Circuit coupling and matching techniques, input and load matching. Oscillators & Mixers:Tunable and crystal oscillators; frequency multiplication. Frequency conversion and mixers: balanced diode and MOSFET designs. RF Detection & Amplification: AM and FM detection methods with emphasis on IC circuit-based designs; Small-signal tuned amplifiers design; Design of broad-tuned RF amplifiers using the Linvill method. Power amplifiers and modulators, class B and C designs. Noise considerations. The stereo-multiplex technique.

EEE 551: TELEVISION ENGINEERING

Elements of television systems. Analysis and synthesis of television pictures. Composite video signals. Signal transmission and channel bandwidth. Picture tubes. Basic television broad-casting. Antennas. Television signal receiver. Video detector. Video section fundamentals. Video amplifiers. Automatic gain control. Noise cancelling circuits. Sync separation circuits. Sync processing. Automic Frequency Control circuits. Deflection oscillators. Applications of Television.

EEE 533: ELECTRONIC CIRCUITS AND SYSTEMS

Review of some common circuit configurations. Linear circuit techniques including current mirrors, current and voltage reference sources, control of drift due to temperature, input and output stages, frequency compensation. Limitations of IC technology current status.

Multiplier circuits and applications. Wideband amplifier techniques. Voltage-controlled oscillators. Phase-locked loops and applications. Digital-to-Analog and Analog-to-Digital converters. Monolithic voltage regulators. Treatment of some modern electronic systems for example frequency synthesizers, logic analyzers, harmonic analyzers, multichannel micro-computers, instrument control buses.

EEE 543: RELIABILITY ENGINEERING

Concepts of reliability: definition, failure frequency, distribution of failures, failure rate and failure probability. Statistical reliability and estimation for components system selection: exponential formula for chance and wear-out failure, confidence limits, cumulative and conditional probability, Poisson distribution, series, parallel, redundancy and Bayer theorem. System design and development: design reliability analysis, dc-rating techniques. Tolerance design. Design simplification. Component reliability characteristics. Failure modes and effect analysis, fault free analysis. Prototype and sequential tests. Evaluation of systems reliability using Monte Carlo technique. System maintenance: planned and preventive maintenance, man-hour calculations, system utilization factor, maintainability design and modelling, equations for system availability and dependency. Spares and manuals.

EEE 528: PROGRAMMABLE DEVICES

Principles of Digital and analogue Programmable Devices, applications of programmable devices, interfacing, designing, programming and compiling, testing, prototyping and implementation.

EEE 559: DATA STRUCTURES AND ALGORITHMS

Algorithms for storing, search, listing, and updating various types of data structure: graphs, linearly linked lists, mult-linked structures, data abstraction, database manipulation, sorting, searching, and storage techniques; memory management; file handling: sequential, direct, and indexed files. Basic concepts and analysis of data representation and associated algorithms illustrated in a suitable programming language such as Ada, Pascal, C++, java.

EEE 507: ENERGY MANAGEMENT AND ENVIRONMENTAL PROTECTION

This course offers a thorough introduction to methods for the evaluation of the environmental consequences of energy systems. Methods include human and ecological risk analysis and external cost analysis. Students learn how to evaluate environmental stresses and human health consequences of energy technologies. The course covers the use of toxicological and epidemiological data in risk assessment, assessment of chemical fate and exposure, and evaluation of climate change. Through a combination of these methods, students will be able to gain a comprehensive understanding of the environmental consequences of today's energy systems.