BACHELOR OF ELECTRICAL ENGINEERING

I. First Year - First Semester

(Hum/T/A) HUMANITIES-A

ENGLISH

2 classes per week x 14 weeks = 28 classes.

Internal Assessment 2 weeks.

Teaching: 24 classes.

1. Basic writing skills: based on Sections 1 and 2 of English for All = 8 classes (4 weeks).

2. Communication skills.
   a. Report writing = (4 classes) 2 weeks
   b. Précis writing = (4 classes) 2 weeks
   c. CVs and resumes = (4 classes) 2 weeks
   d. Reading scientific papers: Scholarly conventions = (4 classes) 2 weeks

3. Two prose extracts from English for All (may be changed from time to time: proposal for this year, JBS Haldane, “Scientific Research for Amateurs” and Rabindranath Tagore “The Religion of the Forest”) = (4 classes) 2 weeks.

4. One short story from English for All (may be changed from time to time: proposal for this year, James Thurber, “The Secret Life of Walter Mitty”) = (4 classes) 2 weeks.

Group presentations in class to be encouraged.

SOCIOLOGY

Postindustrial society- Post-Fordism and the Flexible Firm

Development - Conceptions of and approaches to development - The Roles of State and the Market in the Development

Globalization: The concept of globalization - globalization and the nation state - Development and globalization in post colonial times.

Industrial Policy and Technological change in India - The nature and Role of the State in India

Technology Transfer: The Concept and Types of Technology Transfer-Dynamics of Technology Transfer

Technology Assessment: The Concept - Steps involved in Technology Assessment

Environment: Sociological Perspectives on Environment - Environmental Tradition and values in ancient India

Development and globalization in post colonial times.

Industrial Policy and Technological change in India - The nature and Role of the State in India

Technology Transfer: The Concept and Types of Technology Transfer-Dynamics of Technology Transfer

Technology Assessment: The Concept - Steps involved in Technology Assessment

Environment: Sociological Perspectives on Environment - Environmental Tradition and values in ancient India

The Development of Management: Scientific Management - Organic Organization - Net Work organization - Post modern Organization - Debureaucratization - Transformation of Management

Technological Problems and the Modern Society: Selected Case Studies - Electric Power Crisis, Industrial and/or Environmental Disaster, or Nuclear Accident

(EE/T/111) PRINCIPLES OF ELECTRICAL ENGINEERING-I


A.C. Fundamentals - Periodic waves and Sinusoids. Average and RMS values. Phasor concepts of sinusoids.

Impedance and Admittance. Power, VA, VAR and Power Factor.


Power factor correction.

Network Theorems – Kirchoff’s laws, Loop-current method, Superposition theorem, Thevenin’s and Norton’s theorems, Maximum power transfer theorem, Star-Delta conversion, Nodal Analysis. Related problems on A.C. and D.C. circuits.

Electromagnetism- Ampere’s law, Magnetic field intensity, Magnetic flux and flux density, MMF, Magnetic circuit, Permeability, Reluctance and Permeance, Leakage and fringing.

Concept of inductance, Stored energy, Lifting power.


Electrostatics – Coulomb’s law, Electric charge, Gauss theorem, Electric flux and flux density, Electric field intensity, potential and potential gradient.

Concept of capacitance, Different types of capacitors – parallel plate, cylindrical, spherical capacitors with homogeneous and composite dielectric.
Stored energy in capacitors, Series-parallel combination of capacitors, Capacitor banks and rating of capacitors.

Reference Books:

1. Advanced Electrical Technology – H. Cotton
2. Electrical Technology – Hughes
3. Alternating Current Circuits – Kerchner and Corcoran
4. Fundamentals of Electrical Engineering – Ashtaq Husain
5. Applied Electricity for Engineers – Bessonov
6. Electrical Engineering Fundamentals – V. Del Toro
7. Electrical Science- Choudhury, Chakraborty and Chatterjee

(EE/Math/T/112) MATHEMATICS-IF
(Feedback from Mathematics Dept is awaited)

Functions of a single variable: Rolle’s Theorem; Mean value theorem; Taylor’s Theorem; MacLaurin’s series- indeterminate forms; Maxima and minima.
Functions of several variables: limit and continuity; Partial derivatives; differentials; partial derivatives of a composite function; implicit functions; Taylor’s Theorem; Maxima and minima- Lagrange method.
Riemann Integration- definition and properties. Fundamental theory of integral calculus; improper integrals; gamma and beta functions. Multiple integrals- definition of double and triple integrals; properties and applications.
Fourier series: Periodic functions, Trigonometric series of sine and cosines. Euler formulae, Dirichlets’ conditions, even and odd functions, half range sine and cosine series, Fourier series in intervals, multiple Fourier series, Discrete-time Fourier series.

Sequence; Infinite series- Comparison test, D’Alembert’s test, Cauchy’s root test.

Reference Books:

(EE/Math/T/113) MATHEMATICS-IIIF
(Feedback from Mathematics Dept is awaited)

Solid Geometry: Cartesian coordinates in three dimensions, direction cosines.

Vector Algebra: Addition and subtraction, products of vectors, Different types of of vectors.

Vector calculus: Scalar and vector fields, Concepts of gradient, divergence and curl, Laplace operator and their expression in Cartesian, Cylindrical and Spherical coordinate systems. Gauss, Stokes’ and Green’s theorem.

Ordinary Differential equation: 1st order exact equations, first order linear equations. Second order linear equation with constant co-efficients. Euler Cauchy equation, method of variation of parameters.

Reference Books:

(AM/ME/T/1A) ENGINEERING MECHANICS


(Ph/T/1A) PHYSICS-1A

42 Lecture hours in semester + help room

1. Scalar and vector fields, Gradient of a scalar field, Physical interpretation of gradient, Divergence and curl of a vector field, Conservative vector fields and their potential functions – gravitational and electrostatic examples. (4)
2. Simple harmonic motion, free vibration, damped and forced vibration, resonance. Wave motion, Superposition principle, phase velocity and group velocity. (4)
3. Motion of fluid, Bernoulli’s theorem, Poiseuille’s equation for the flow of liquid through a narrow tube, Motion of a body through a viscous medium: Stokes’ law. (4)
4. Overview of Coulomb’s law, Gauss’s law, dielectric polarization, Displacement vector, Overview of Biot Savart law and Ampere’s Circuital law. (4)
5. Time-varying field, Faraday’s law of electromagnetic induction, Transient phenomena in electric circuits (series L-R, series C-R), Electrical oscillations in L-C circuit. Alternating voltage applied to series L-C-R circuit and the idea of electrical resonance. (5)
6. Macroscopic and microscopic description, Thermal equilibrium, Zeroth law of thermodynamics, Heat and Work, First law of thermodynamics and some applications, Reversible and irreversible processes, Carnot cycle, Second law of Thermodynamics, Concept of entropy. (6)
7. Interference of light waves, Young's experiment, Spatial and temporal coherence, Interference in thin film, Newton's rings, Diffraction of light waves, Fraunhoffer diffraction due to single slit and plane diffraction grating, Polarisation of light waves, Polarisation by reflection, Brewster's law. (9)
8. Wave particle duality, de Broglie waves and uncertainty principle, Concept of wave function and its physical interpretation. Normalisation, 1-D Schrödinger equation – 1-dimensional (infinite) potential well. (6)

(Ph/S/1) PHYSICS LABORATORY-I

Students have to perform experiments from the following list.

1. Determination of Young’s modulus by Flexure method.
2. Determination of moment of inertia of a cylindrical body.
3. To determine co-efficient of viscosity by Capillary flow method.
4. Determination of co-efficient of linear expansion by optical lever method.
5. Determination of focal length of a concave lens by combination method.
6. Determination of refractive index of the material of the glass prism by prism spectrometer.
7. To find the wavelength of a monochromatic light by single slit.
8. To find the wavelength of a monochromatic light by Newton rings.
11. To find high resistance by Galvanometer deflection method.
12. To measure mechanical equivalent of heat, J by electrical method (Joule's) using copper calorimeter (radiation correction to be done).
13. To compare two low resistances by drop of potential method.
14. To determine resistance per unit length of a wire by using Carey Foster bridge.
15. To estimate strength of current by using copper voltmeter.
   a) To compare the EMF's of two cells by using a potentiometer
   b) To measure current by using a potentiometer
16. To measure the horizontal component of earth's magnetic field using deflection and vibrating magnetometers.

(BED/ME/S/1) BASIC ENGINEERING DRAWING

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension. Projection: orthographic and isometric, sectional views.

( Feedback from Mechanical Engg Dept is awaited)

(WS/ME/S/6A) WORKSHOP PRACTICE-VI (Carpentry and Fitter Shop)

Introduction to types of Indian woods used for engineering purposes and carpenter’s tools; use of wood working machines; making of selected joinery. Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.
(WS/ME/S/10) **WORKSHOP PRACTICE-X**

**Forging and Welding**

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding. Introduction to and practice of different welding processes- gas, SMAW, TIG, MIG, SAW, resistance welding etc.; introduction to gas cutting and its application; soldering, brazing etc.; making welded joints using different welding processes.

(Feedback from Mechanical Engg Dept is awaited)

Theory – 19 pds.  Sessional- 12 pds.  TOTAL- 31 pds.

II. First Year - Second Semester

(EE/T/121) **PRINCIPLES OF ELECTRICAL ENGINEERING-II**

Network Theorems – Reciprocity theorem, Compensation theorem, Substitution theorem, Tellegen’s theorem and Millman’s theorem for voltage and current sources. Problems.

Locus diagram – series circuits of variable impedance: constant reactance, variable resistance; constant resistance, variable reactance; series resonance by varying frequency; Admittance locus diagram, parallel circuit with variable impedance, parallel resonance circuit by varying inductance, parallel resonance by varying capacitance, resonance at all frequency (a singular case of parallel resonance).


Principle of Transformer – E.m.f. equation, Transformer on No-load and On Load, Equivalent circuit of transformer.

Nonlinear circuit analysis – Nonlinear resistances and inductances, series and parallel combination of linear and nonlinear resistances and inductances, Application of graphical techniques.

Three-phase A.C. circuit – Three phase A.C. balanced circuits, Balanced supply with three wire and four wire. Three phase power measurement.
Unbalanced system, Definition of power factor for unbalanced system, Analysis of unbalanced three phase system by symmetrical components.

Ferro-resonance phenomenon.

Non-sinusoidal periodic waves – Harmonics, Generation of harmonics by nonlinear circuit elements, Harmonic decomposition of periodic waves, r.m.s. and average values. Harmonics in three-phase system.

**Reference Books:**

1. Advanced Electrical Technology – H. Cotton
2. Electrical Technology – Hughes
3. Alternating Current Circuits – Kerchner and Corcoran
4. Fundamentals of Electrical Engineering – Ashfaq Husain
5. Applied Electricity for Engineers – Bessonov
6. Electrical Engineering Fundamentals – V. Del Toro
7. Electrical Science- Choudhury, Chakraborty and Chatterjee
8. Theory and Practice of Alternating Current Circuits – A.T. Dover

**(EE/ET/T/122) ELECTRONICS-I**

Elementary Physics: Semiconductor Materials; Intrinsic and Extrinsic Type; Characteristics of P-N Junction. Basic Semiconductor Devices: P-N Junction Diode; Schottky Diode; Zener Diode; Bipolar Transistor; JFET; MOSFET. Modelling of Semiconductor Devices: Hybrid parameters. Biasing: CE, CB and CC Transistor Configuration; JFET and MOSFET. Feedback amplifiers: Characteristics of Negative and Positive Feedback. Transistor Power Amplifiers: Class A, AB, and Complimentary Symmetry. Operational Amplifiers: Characteristics; Inverting, Non-Inverting, Summing and Differentiating Amplifiers; Integrator and Differentiator; Voltage Comparator; Precision Rectifier; Sample and Hold; Study and application of integrated circuit like 741. Waveform generators: Sine, Square, Triangular and Sawtooth. Opto-Electronics: Elementary Physics; LED; LCD; Photo-Diodes; Photo-Transistors; LDR; 7-Segment and Alpha-Numeric Displays; Opto-Isolators and Interrupters.

**(EE/Math/T/123) MATHEMATICS-IIIIF**


Partial differential equations: Solution of one dimensional wave and diffusion equations and Laplace’s equations of two dimensions by method of separation of variables.
Integral transforms: Laplace transform and Fourier transform, Properties and applications to differential equations. Discrete Fourier transform, Z-Transform, applications to difference equations.

Complex analysis: Functions of a complex variable, limits, continuity and differentiability. Cauchy-Riemann equations for complex integration; Cauchy’s fundamental theorem, Cauchy’s integral formulae, Taylor’s Theorem, Laurent’s theorem, Singularity, Residue Theorem, Contour Integral.

**Reference Books:**

(Feedback from Mathematics Dept is awaited)

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**AM/ME/T/3**  **STRENGTH OF MATERIALS**

(Feedback from Mechanical Engg Dept is awaited)

Uniaxial stress field, Thin pressure vessels, Torsion (inclusive of Helical spring), shear force and Bending moment, Bending and shear stress in beams, Deflection beams, Energy methods in Strength of Materials, Problem of Plane stress and strain, Theories of failure, Buckling of columns.

**Reference Books:**

**EE/ME/T/124**  **THERMODYNAMICS AND HEAT POWER ENGINEERING**

(Feedback from Mechanical Engg Dept is awaited)

Ideal or perfect gases: laws, properties, equation of state, gas constants, internal energy and enthalpy of perfect gas, P-V and T-S planes, P-V relations, work done, Heat transferred. Laws of thermodynamics Adiabatic, Isothermal and polytropic processes, Carnot, Otto and Diesel cycles. Vapour formation at constant pressure: saturated and superheated steam, enthalpy of steam throttling, steam table, P-V, T-S, diagrams, steam cycles, pump work, thermal efficiency. Basic laws of heat conduction, general heat conduction equation, boundary conditions, one dimensional heat conduction equation solutions, electrical analogy.

**Reference Books:**

**Ph/T/2B**  **PHYSICS-2B**
42 lecture hours in semester + help room

1. Wave particle duality, de Broglie waves and uncertainty principle, Concept of wave function and its physical interpretation. normalization, 1-D Schrödinger equation –1- D (infinite) potential well. Time dependent Schrodinger equation for a free particle, stationary states. (9)
2. Postulates of quantum mechanics, expectation values of physical observables, energy eigen values and eigen functions for particle in a box, Square well potential, reflection and transmission coefficient in potential barriers. (8)
3. Statistical description of a system of particles, Phase space, Microstates and macrostates, Boltzmann's formula for the entropy, Boltzmann distribution function (derivation not reqd.) Classical ideal gas, Equipartition theorem and its applications. (9)
4. Time-varying field, Faraday’s law of electromagnetic induction, Transient phenomena in electric circuits (series L-R, series C-R), Electrical oscillations in L-C circuit. Alternating voltage applied to series L-C-R circuit and the idea of electrical resonance. (8)
5. Generalization of Ampere’s circuital law, Maxwell’s equations, Poynting theorem, Poynting vector. Maxwell’s wave equation in free space and its solution. (8)

(Ph/S/2) PHYSICS LABORATORY-II

Students have to perform experiments from the following list.

1. Determination of Young’s modulus by Flexure method.
2. Determination of moment of inertia of a cylindrical body.
3. To determine co-efficient of viscosity by Capillary flow method.
4. Determination of co-efficient of linear expansion by optical lever method.
5. Determination of focal length of a concave lens by combination method.
6. Determination of refractive index of the material of the glass prism by prism spectrometer.
7. To find the wavelength of a monochromatic light by single slit.
8. To find the wavelength of a monochromatic light by Newton rings.
11. To find high resistance by Galvanometer deflection method.
12. To measure mechanical equivalent of heat, J by electrical method (Joule's) using copper calorimeter (radiation correction to be done).
13. To compare two low resistances by drop of potential method.
14. To determine resistance per unit length of a wire by using Carey Foster bridge.
15. To estimate strength of current by using copper voltmeter.
   a) To compare the EMF's of two cells by using a potentiometer
   b) To measure current by using a potentiometer
16. To measure the horizontal component of earth's magnetic field using deflection and vibrating magnetometers.

(AED/ME/S/1) ADVANCED ENGINEERING DRAWING
True length, development of surface of simple objects. Threaded joint & riveted joints, cotter/knuckle joint. Pulley, shaft coupling.

(Feedback from Mechanical Engg Dept is awaited)

(WS/ME/S/12B) WORKSHOP PRACTICE-XII (Machine Shop)

Introduction to machine tools - lathes, drilling machines, shaping machines, planning machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs. Experiments on: Study of the speed structure of a lathe, study of apron mechanism and calibration of feeds in a lathe. Study and grinding of various cutting tools.

(Feedback from Mechanical Engg Dept is awaited)

(EE/S/121) COMPUTER FUNDAMENTALS

Study of basic computer system: Essential parts and their interconnection.
Study of MS-DOS.
Study of WINDOWS and a few applications like MS-WORD, MS-EXCEL etc.
Developing algorithms for programming with branching, looping, arrays etc and their implementation in BASIC/FORTRAN.
Basic concepts of Database Management Systems.
Basic concepts of computer network.

Theory – 19 pds.  Sessional- 12 pds.  TOTAL- 31 pds.
III. Second Year First Semester

(EE/T/211) **CIRCUIT THEORY**


**Reference Books:**


(EE/T/212) **BASICS OF NUMERICAL METHODS AND PROGRAMMING**

Number representation, machine precision, round off and truncation error, accuracy of numerical calculation on digital computers. Solution of simultaneous linear equation, evaluation of determinant and matrix inversion by direct approach e.g., Gaussian elimination, Gauss Jordan elimination, L-U factorisation, and Q-R factorisation method and iterative approach e.g., Jacobi, Gauss-Seidel and Relaxation methods. Ill-conditioned system, vector and matrix norm, condition number. Eigen values and Eigen vectors. Roots of non-linear algebraic equation using iterative methods, e.g., bisection, false position, secant and Newton-Raphson methods. Finding roots of non linear simultaneous equations by Newton Raphson method. Interpolation and curve fitting, piecewise-linear interpolation, polynomial interpolation, Lagrange polynomial interpolation, Newton's forward, backward and divided difference interpolation formulas and errors. Least square curve fitting. Numerical integration, Newton-Cotes Integration


Reference Books:

2. Introductory Methods of Numerical Analysis - Sastry.
3. Programming with C – Gottfried
4. ANSI C – Balaguruswamy
5. Working with C – Y. Kanetkar
6. Turbo C++ - R. Lafore
7. C++ - Balaguruswamy

(EE/T/213) ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

Classification of electrical measuring instruments, general feature of indicating instruments: controlling, damping, balancing. Galvanometer: dynamics, sensitivity, D'Arsonval galvanometer, Ballistic galvanometer, Vibration Galvanometer, PMMC instrument, temperature compensation, rectifier type instrument, Moving iron instrument, errors and compensations, electrodynamometer type instrument, extension of instrument range: - shunt, multiplier, Capacitive voltage divider power measurement for DC ,single and three phase AC circuit low power factor wattmeter, wattmeter connections and errors, Induction type energy meter: characteristics, errors and their compensation, current transformer(C.T.) , potential transformer (P.T.); testing and calibration of measuring instruments.

inductances, interbridge transformer, residuals, errors in bridges, detectors, DC potentiometer: Weston normal cell, Vernier type, Kelvin-Verley slide, dual range, applications, phantom loading, AC potentiometer:- polar type and co-ordinate type, Use of Ballistic Galvanometer in magnetic testing, ac magnetic testing: Lloyd-fisher square, transducers: RTD, thermistor, thermocouple, laws of thermocouple circuits, cold junction compensation, strain gauge.

**Reference Books:**

2. Electrical Measurement : by F. K. Harris
3. Electrical Measurement Analysis : by Ernest Frank
4. Alternating Current Bridge Networks : by Hague & Foord
5. Basic Electrical Measurement : by M. B. Stout
7. A Course in Electrical & Electronic Measurements & Instrumentation by A.K. Sawhney
8. Electronic & Electrical Measurements & Instrumentation by J.B. Gupta

**(EE/ET/T/214) ELECTRONICS-II**


**(EE/T/215) ELECTRICAL MACHINES I**

**PART – I**


DC Generators – Characteristics with different excitation systems, voltage regulation, parallel operation.

DC Motors – Characteristics and applications of Separate, Shunt, Series and Compound motors, methods of starting, speed control, equivalent circuit. Series-parallel operation of motors.

Introduction to Permanent Magnet dc machines.
Testing of dc machines – Swinburne test, Hopkinson’s test, Brake test. Tests specified as per standards.

PART – II


Dry-type and oil cooled type. Natural and forced types of cooling. Tank and radiator construction, operation. Transformer oil. Transformer accessories, eg., conservator, breather, Bucholtz relay, bushing, etc.

Power and Distribution Transformers, all-day efficiency.

Testing of transformers: Polarity of windings, OC and SC test, separation of losses, determination of equivalent circuit parameters. Regulation, efficiency,

Single phase auto-transformers, principle of operation, phasor diagram. Comparison of weight, copper loss equivalent reactance with 2-winding transformer.

Special Transformers: Current transformers, Pulse Transformers.

Reference Books:
1. AC Machines: Puchstein, Lloyd & Hunte
2. Advanced Electrical Technology: H. Cotton
3. Performance and Design of Alternating Current Machines: M.G. Say
4. Principles of Alternating Current machinery: Lawrence
5. Performance and Design of DC machines: Clayton & Hancock.
6. Advanced Electrical Technology: H. Cotton
7. Electrical Machinery : P. S. Bimbhra
8. Electrical Machinery : A. E. Fitzgerald & C. Kingsley
10. Electrical machines: P.K. Mukherjee & S. Chakravorti

(EE/ME/T/216) PRIME MOVERS FOR ELECTRICAL SYSTEMS


Reference Books:

(Feedback from Mechanical Engg Dept awaited)

(EE/S/211) E. E. LABORATORY – I

Selected Experiments in Electrical Machines, Control Systems, Power Systems and Measurements & Instrumentation Laboratories.

(EE/ME/S/212) M. E. LABORATORY – I

Selected Experiments in Applied Mechanics Laboratory.

(Feedback from Mechanical Engg Dept awaited)

(MDD/ME/S/1) MACHINE DESIGN AND DRAWING

(using CAD)

(EE/T/221) ELECTRICAL INSTRUMENTATION

General measurement system. Introduction to transducers. Signal conditioning systems for transducers. Linearization of sensors.
Magnetostriuctive transducers. Basic concepts. Torque measurement using magnetostriective sensing.
Data Converters. DAC: Binary-weighted register, R-2R ladder. DAC characteristics & specifications. DAC errors. ADC: Successive-approximation, Dual-slope, Delta-sigma. ADC codes and errors.
Waveform display devices & applications: CRT, LCD, LED.
PLL and its applications.

**Reference Books:**

1. Measurement Systems-Application and Design: Doebelin
2. Transducers and Instrumentation: D. V. S. Murty
4. Operational Amplifiers: Clayton and Winders
5. Instrument Transducers: Neubert
6. Principle of Industrial Instrumentation: Patranabis
7. Electronic Data Converters: Anvekar & Sonde
8. Analog and Digital Filters: Design and Realization. H. Y. F. Lam
10. Digital Principles & Applications : by Malvino & Leach
11. Modern Electronic Instrumentation & Measurement Techniques : by Helfrick & Cooper
12. Principles of Electronic Instrumentation, D. Patranabis

**EE/T/222 ELECTRICAL MACHINES II**

**PART – I**


Space harmonics: Crawling & cogging.

Tests as per standards.

Operation of the induction machine as a generator.

**PART – II**
Polyphase connections: Star, Delta and Open-delta connections.


Tests as per standards.

Special connections: T connection. Phase shifting connections. Scott and Le-Blanc connection, 3-phase to 1-phase transformation.

Three-phase auto-transformers: different connections.

Reference Books:

1. AC Machines: Puchstein, Lloyd & Hunte
2. Advanced Electrical Technology: H. Cotton
3. Performance and Design of Alternating Current Machines: M.G. Say
4. Principles of Alternating Current machinery: Lawrence
5. Electrical Machinery: P. S. Bimbhra
8. Electrical machines: P.K. Mukherjee & S. Chakravorti

(EE/T/223) ELECTRICAL ENGINEERING MATERIALS

insulating materials: Advantages of using composite insulation; Concept of reinforced materials; Base and filler materials; Applications.


Reference Books:

1. Electrical Engineering Material by A.J. Dekker
2. Electrical Engineering Material by B.M. Tareev
3. Dielectric Materials and applications by A. Von Hipple
4. Transistors : D.L. Croissette

(EE/T/224) SIGNALS & SYSTEMS

PART - I


PART-II

Reference Books:
1. Simon Haykin and Barry Van Veen, “Signals and Systems”.
3. Tarun Kumar Rawat, “Signals and Systems”.
5. F.F. Kuo, “Network Analysis and Synthesis”.

(EE/T/225) POWER SUPPLY SYSTEMS
**Reference Books:**

1. Powerplant Technology by M.M.El-Wakil, McGraw Hill
3. A Course in Power Plant Engineering, by Arora & Domkundwar, Dhanpat Rai
4. Elements of Electrical Power Station Design, by M.V.Deshpande, Wheeler
5. Electric Power Distribution System Engineering, by Turan Gonen
6. Transmission & Distribution, by H.Cotton

**(EE/T/226)SEQUENTIAL SYSTEMS & MICROPROCESSORS**

**Part -I**
Sequential Circuits. State machines and State diagrams. Present State Table, Next State Table.
Relay logic and switching algebra
Ladder diagram representation of sequential systems.
Design of elementary sequential systems.
Petrinet representation and case studies
Memory Interfacing : Memory Map, Address decoding, word-size expansion, capacity expansion.
Algorithmic Sequential Machines
Design of Direct Addressed and Indirect Addressed ROM based Sequential systems, Case Studies.
State Assignment for Minimisation of Output Forming Logic. State assignment to eliminate output glitches.
Microprocessor as an FSM/ASM.

**Part -II**
Microprocessor Architecture : Address / Data and Control lines, Timing diagrams, Internal registers, Interrupt mechanism (Hardware/Software), DMA mechanism - [NB. Study mainly based on Intel 8085 and other popular microprocessors].
Detailed description of a typical 8-bit Microprocessor (preferably 8085).
Interfacing with support chips : Programmable Peripheral Interface (8255), Programmable time/counter (8253), Programmable UART (8251), Programmable Interrupt Controller (8259), DMA Controller (8257), Programmable Keyboard and Display Controller (8279) - signals and timing details along with hardware/software interfacing techniques.
I/O interfaces with switch, multisegment display, ADC/DAC


**Reference Books:**


**(EE/S/221) E. E. LABORATORY – II**

Selected Experiments in Electrical Machines, Control Systems, Power Systems and Measurements & Instrumentation Laboratories.

**(EE/S/222) COMPUTER PROGRAMMING LABORATORY**

Programming in C.

Concept of Object Oriented Programming: Programming in C++.


**(EE/ET/S/223) ELECTRONICS LABORATORY**

Selected experiments on analog and digital electronic circuits.

**(EE/ME/S/224) M. E. LABORATORY – II**

Selected Experiments in Heat power and Hydraulics Laboratory.

**Feedback from Mechanical Engg Dept awaited**

Theory – 18 pds.  Sessional- 12 pds.  TOTAL- 30 pds.
V. Third Year First Semester

(EE/T/311) DIGITAL SIGNAL PROCESSING


Introduction to image processing: gray image as a 2-D continuous function of space. Image filtering: a 2-D filtering problem, FIR image filters for low pass and high pass filtering. Contrast enhancement by histogram equalization.
Reference Books:

2. Signals and Systems-- Simon Haykin and Barry Van Veen.
3. Network Analysis and Synthesis--- M.E. Van Valkenburg

(EE/T/312) ELECTRICAL MACHINES III

PART – I


Shaded-pole type motor : Construction and operating principle. Operating characteristics.

Repulsion start 1-phase induction motor : Operating principle. Operating characteristics.

AC Commutator motors : Transformer and rotational emf’s in phase and commutator windings. Expression for torque and power. Action of commutator as frequency converter. Study of the AC Plain Series motor, its phasor diagram, commutation, brush emf’s, design features. Use of compensating and compole winding to improve power factor and commutation.

PART – II

methods. Two-reaction Theory. Damper windings. Short circuit, Transient and sub-transient reactances. Determination of $X_s, X_d, X_q, X_{1}, X_{2}, X_0, X_d', X_q', X_d'', X_q''$. Methods of voltage control and schemes for excitation systems.

Synchronisation of alternators, power flow, power angle characteristics, operating chart, synchronizing power, stability. Excitation characteristics, V-curves, parallel operation.

**Synchronous motors**: Power developed, circle diagrams for constant power developed and constant excitation. V-curves and O-curves. Starting methods. Synchronous induction motor. Operation as synchronous condenser.

**Introduction to Permanent Magnet synchronous machines.** Tests as per standards.

**Reference Books:**

1. *AC Machines*: Puchstein, Lloyd & Hunte
2. *Advanced Electrical Technology*: H. Cotton
3. *Performance and Design of Alternating Current Machines*: M.G. Say
4. *Principles of Alternating Current machinery*: Lawrence

**(EE/T/313) POWER SYSTEM PLANNING AND DESIGN**


Reference Books:

3. Electrical Power Systems, by Ashfaq Husain, Vani educational Books

(EE/T/314) **LINEAR CONTROL SYSTEM**

**Part I**

Introduction to Control Systems: Classification of control systems with examples.


Time response of system: Time domain specifications, Ramp response of second order system, concept of dominant poles, Time response with NMP zeros.

Review of frequency domain methods: Bode and Nichols plots. Frequency Domain Specifications in open loop and closed loop and their significance, Concept of Bandwidth (3 dB BW & 90 degree BW) and Cut-off frequency, Effect of addition of poles and zeros on Bandwidth.

Control system components: Position and velocity sensors and encoders, servomotors and voice coil actuators.

Case Studies: Performance analysis of remote position control system and generator voltage regulation.

Basic Control actions: Proportional, integral, derivative, and their combinations.

Design and compensation of control systems in frequency domain: Lag compensator, lead compensator, lead-lag compensator and lag-lead compensator.

**Part II**


Root locus analysis. Effects of system gain and additional pole-zeros on stability.

Block diagram representation of control systems: block diagram reduction and signal flow graph analysis.

State variable analysis: Concept of state, state variable, state model. State variable formulation of control system, diagonalization, Relating transfer function with state

**Reference Books:**


(EE/T/315) **FIELD THEORY**

Electric vector field and scalar potential field, Relation between electric field intensity and potential, Gauss’s integral law for electric displacement field, electric dipole fields, Electric polarization, and its relation to the permittivity of dielectric media, Physical interpretation of gradient, divergence theorem, Gauss’s law in differential form, Poisson’s and Laplace’s equations, These equations in cartesian, cylindrical and spherical coordinates, Matching boundary conditions at the interface of different dielectric media, Electric stress and mechanical force in charged conductors, Energy stored in electric field, Solution of Laplace’s equation by separation of variables method, Capacitance of coaxial cables and two wire transmission lines and related electric fields, Numerical analysis of electric fields by solving Laplace’s equation, Iterative methods, Finite elements. Uniqueness theorem, Method of Images for the solution of electric fields. Magnetic field intensity, Lorentz force, Motoring and generating principles, Physical interpretation of curl and stoke’s theorem, Ampere’s law in both integral and differential forms, Scalar and Vector magnetic potential and deduction of Biot-Savart’s law and its application for different current configuration, Boundary conditions, Solution of field problem by image method, Self and mutual inductance, Inductance of coaxial cable and two wire transmission lines, Energy in magnetic field, Force due to magnetic field in magnetic medium, Faraday’s Law of electromagnetic induction, Maxwell’s field equations, Displacement current density and continuity equation, Electromagnetic wave equations in loss-free and lossy media, Plane and polarized waves and their propagation as solutions of wave equation, propagation, attenuation and phase constants, intrinsic impedances, Poynting’s vector, Poynting’s theorem, Power flow through electromagnetic media, Elements of wave guide and radiating systems (antenna), Diffusion equation for eddy currents and skin effect.

**Reference Books:**

1. Engineering Electromagnetics: W.H.Hayt
2. Electromagnetics: Kraus & Carver
3. Electromagnetic Theory and application: P.Mukhopadhyay
4. Electromagnetics: Edminister

(EE/T/316) PROGRAMMABLE LOGIC
& MICROCONTROLLER

Part -I
Programmable Logic Devices : Concepts of PLA, PAL and FPGAs, Architecture, Basic Design Process.
Introduction to VHDL language basics. Modelling combinational and sequential logic systems. Simulation and testing.
Types of FPGAs
Xilinx solutions : Xilinx CPLDs and applications areas.
JTAG Development and Debugging Support.

Part -II

Reference Books:

1. Introductory VHDL: From Simulation to Synthesis by Sudhakar Yelamanchilli, Pearson Education.
2. A VHDL Primer by J. Bhasker, Pearson Education.


(EE/S/311) E. E. LABORATORY – III

Selected Experiments in Electrical Machines, Control Systems, Power Systems, High Voltage and Measurements & Instrumentation Laboratories.

(EE/S/312) ELECTRICAL MACHINE DESIGN – I

Design of 1-phase transformers, lifting magnets and reactors.

Reference Books:


(EE/S/313) MICROPROCESSOR AND MICROCONTROLLER LABORATORY

Hand on experience with different microprocessor and microcontroller systems and their interfaces.

VI. Third Year Second Semester

(EE/T/321) INTRODUCTION TO STATISTICAL AND PROBABILISTIC METHODS


Sampling theory – sample mean, sample variance. Parameter estimation: point estimates, criteria of good estimators, maximum likelihood estimators. Interval estimates, statistical confidence, concept of confidence interval. The Bayes estimation. Statistical hypothesis testing: null hypothesis and alternative hypothesis, tests for differences in means, differences in variances. Significance levels. Two-tailed and one-tailed tests. Type I and Type II errors. Large sample and small sample tests for statistical significance using Normal and Chi-Square distribution. Fitting theoretical distributions to sample frequency distributions.


Introduction to analysis of variance. Goodness of fit: Chi-Square test, Kolmogorov-Smirnov test, least-squares test. Nonparametric hypothesis tests: the sign test, the signed rank test.


Reference Books:
1. Probability, random variables, and random signal principles – Peyton Z. Peebles, Jr.

(EE/T/322) POWER ELECTRONICS

PART – I


Push-pull, Half-bridge and Bridge inverters. Methods of voltage control: dc bus variation and PWM.

SCR forced commutation techniques and their application to choppers and inverters. Current Source Inverters.

Principles of isolated dc/dc converters and SMPS.

PART – II

Input and output characteristics of common rectifier topologies: Single-phase half-wave and full-wave Diode rectifiers with R, RL, RC and RLE load. Study of same with highly inductive load. Effect of Free-wheel diode. Output average voltage for ‘m’ pulse diode rectifier. Three-phase half-wave and full-wave Diode rectifiers with highly inductive load. Introduction to higher pulse rectifier systems and use of Inter-Phase Reactor.

Commutation effects, overlap angle and voltage loss. Input current harmonics and power factor, output voltage ripple & harmonics.


Line Commutated SCR inverters, reverse power flow.

Principle operation of the Cyclo-converter.

Reference Books:

2. V. Subrahmanyam, “Power Electronics”, New Age International (P) Ltd.

(EE/T/323) POWER SYSTEM PERFORMANCE

Per-Unit representation of Power system— Selection of base quantities, percent and per unit values, advantage of per unit system. AC Transmission – Power flow through a line, power circle diagram, line charts, active power flow and voltage control in transmission system. Line loadability and voltage dependence. Power flow in interconnected systems and load flow analysis – Gauss –Seidel method. Symmetrical fault analysis . Elements of HVDC Power transmission. Basic concept of active and reactive power control of Synchronous generator. Interdependence of active power with frequency and reactive power with voltage and concept of decoupling. Speed Governing System: Description of Speed Governor, Speed changer and main components of speed governing system, principle of operation. Load frequency control: Representation of speed governing system, effect of governor droop on load sharing among generators ,dependence of load on frequency, system inertia. Modeling and analysis of single area load-frequency control, supplementary control, concept of control area. Multi area load frequency control problem and concept of tie line control. Reactive power control: Role of excitation system, main & pilot exciters, description of different types of excitation systems.


Reference Books:

(EE/T/324) PROCESS INSTRUMENTATION AND CONTROL

Part I


Importance of time delay in process control loop. Practical examples. Smith predictors/controllers.


Part II

Concept of Processes and Units: Process statics, steady state operating point, mass and enthalpy balance.

Modelling of process dynamics: Modelling of simple Industrial processes. Standard first order process model with delay, time and frequency response of standard first order process model with delay.

Single loop control of standard first order process plants: P, PI, PD and PID control, Controller tuning, Frequency domain design, Ziegler-Nichol's and other empirical tuning methods.

Feedforward control: configurations, advantages, limitations and industrial applications.
Multiloop and Cascade control: configurations, interaction and decoupling, industrial applications.

Ratio control: principles, configurations including cascade configuration.

Case study: Boiler Control.

**Reference Books:**

1. Principles and Practice of Automatic Process Control - Smith and Corripio
2. Principles of Process Control - Patranabis
3. Automatic Process Control - Eckmann
4. Process Control Systems - Shinskey
5. Process Systems Analysis and Control - Coughanowr & Koppel
6. Chemical Process Control – Stephanopoulos

**(EE/T/325) ELECTRICAL UTILISATION & ILLUMINATION ENGINEERING**

**PART – I**

**Harmonic current generation due to non-linear loads.** Effect of Harmonic currents on power supply system and its components. Power factor degradation due to harmonics. Displacement Factor, Distortion Factor and Harmonic Factor. Power line filters. Concepts of static Var compensators. Introduction to near-unity power factor rectifiers and Active Power Filters.

**Electric heating**: Basic advantages, classification of furnaces and ovens. Industrial application areas.

Resistance Heating: basic principles of direct and indirect heating types. Control of heating: on-off control, graded resistance, tapped inductor. Solid state control - SCR on-off control, ac phase control, integral cycle control.

Arc Furnaces: basic principles of direct and indirect heating types. 1-phase and 3-phase AC and DC arc types. Their power supply regulator system. Electrode position control system.

Induction Heating: basic principles and applications.

Induction Furnaces: basic principles of coreless and core types. Their power supply systems. SCR resonant inverters for induction heating.

Dielectric Heating: basic principles and applications.

**Principle of Thermostat control for cooling.**

**Storage Batteries**: common types and their characteristics. Principles of charging, modes of charging, eg., tickle, float, boost, constant current, constant voltage etc. Charge termination methods, common charger types. Temperature compensation of charging voltage. Battery size estimation.

**Uninterruptible Power Supplies**: Basic concepts, schemes, back-up, redundancy, transfer switch.

**AC Voltage Stabilisers**: Basic principles like tap-changing, servo-controlled buck-boost transformer, Constant Voltage Transformer.
PART – II

Light and electromagnetic radiation; sources of light-thermal radiator-blackbody radiator, laws of thermal radiation; daylight and artificial light, spectral power distribution (SPD) of light sources. Radiometric and Photometric quantities, visual response curve of standard observer, relation between lumen and watt, photometric standards, Laws of illumination, perfect diffuser, Lambert’s law.


Reference Books:

8. Lighting for energy efficient luminous environments- Ronald N. Helms & M Clay Belcher.
9. Lighting- D.C. Pritchard

(EE/T/326) HIGH VOLTAGE ENGINEERING

High voltage power transmission and distribution. Insulators: Type of insulators and their applications, voltage distribution and string efficiency of disc insulators. Corona: Theory of corona formation, corona loss and radio interference. Overvoltage phenomena: Lightning and switching surges. Travelling waves: Reflection and refraction w.r.t. different type of line terminations. Overvoltage protection: Grounding practice and over-voltage due to earth fault, lightning arresters and surge suppressors. Insulation coordination scheme of open-air substation. High voltage cables: Single core, belted,


Reference Books:

1. High Voltage Engineering – Kuffel and Zaengl
3. High Voltage Engineering – D.V.Razevig
4. High Voltage Engineering – Naidu & Kamaraju

(EE/S/321) E. E. LABORATORY – IV

Selected Experiments in Electrical Machines, Control Systems, Power Systems, High Voltage and Measurements & Instrumentation Laboratories.

(EE/S/322) ELECTRICAL MACHINE DESIGN – II

Design of integral h.p dc Machine and 3-phase transformer.

Reference Books:


(EE/S/323) POWER SYSTEM DESIGN

Problems on power transmission and distribution system design.
Introduction to Matlab/Simulink: Basic matrix operation, file operations, plotting, Matlab program development in command window. Simulation of problems on Matlab/Simulink related to:

– Modeling of 1st and 2nd order systems. Study on time domain and frequency domain behavior.
– D.C. circuit transients in time domain.
– A.C. circuit response in time and frequency domain.
– Simulation of D.C. shunt motor and open loop response.
– Simulation of series and shunt faults in transmission lines.
– Simulation of load frequency control for single-area and two-area power system.
– Simulation of sampling and aliasing phenomenon. Study on quantization error of ADC.
– FFT and Inverse FFT of harmonic rich signals.
– Design of IIR and FIR filters and study on effect of finite wordlength.
– Simulation of ?-circuit long transmission line and study of wave propagation.
– Modeling of illumination level at working plane.

VII. Fourth Year – First Semester

(EE/T/411) PRINCIPLES OF COMMUNICATION ENGINEERING AND COMPUTER NETWORKS

Part I: Communication Engineering


Analog Communication: Amplitude Modulation (AM), Modulation Index, Double-Sideband -Suppressed Carrier (DSB-SC), Conventional Double Sideband (DSB) and Single Sideband (SSB) Modulation, Demodulation of AM Signals, AM Modulators (Power-law Modulators, Switching Modulator, Ring Modulator) and Demodulators (Synchronous Demodulator, Rectifier Detector, Envelop Detector), Frequency Division Multiplexing (FDM), Angle Modulation: Frequency and Phase Modulations (FM & PM), Narrowband and Wideband FM, FM Modulators and Demodulators, Direct and Indirect FM, Balanced Discriminator, FMFB and PLL FM Demodulators, AM and FM Radio Broadcasting, Superheterodyne AM and FM Receivers.

Digital Communication: Digital Communication Systems, Communication Channels (AWGN, Bandlimited, Multipath and Fading Channels), Introduction to Baseband and Bandpass Digital Modulations, Concepts of Power Efficiency, Bandwidth Efficiency, Inter-Symbol Interference (ISI), Bit-Error Rate (BER), Formatting And Baseband Modulation, Messages, Characters, and Symbols, M-ary Communication, PAM, PDM, PPM, Pulse Code Modulation (PCM), Delta Modulation, Uniform and Non-Uniform Quantizations, Comanding, Time-Division Multiplexing (TDM), Baseband Demodulation, Digital Bandpass Modulation & Demodulation (Detection), Coherent Detection, Non-Coherent Detection, Frequency Shift Keying (FSK), Binary FSK Signals (BFSK), BFSK Modulator, BPSK Coherent and Non-Coherent and Demodulators, Amplitude Shift Keying (ASK), Phase Shift Keying (PSK), BPSK, BPSK Modulator, BPSK Coherent and Non-Coherent and Demodulators, Overview of M-ary PSK, Quadrature PSK and Minimum Shift Keying (MSK).


Wireless Communications: The Cellular Concept, Personal Communication Services (PCS), Hierarchical Architecture of a Personal Communication Services Network
(PCSN), Radio Resource Management in PCS, Multiple-Access Techniques, FDMA, TDMA, CDMA, Channel Assignment, Frequency Reuse, Cell Splitting, Mobility Management, Handoff Management, Inter-Switch Handoff, Location Management, Location Update, Call Delivery and Terminal Paging, GSM (2.5 G) and UMTS (3G) Architectures.

Part II: Computer Networks


Local Area Networks (LAN), IEEE 802.3, 802.5 Standards, Token Ring, Token Bus, CSMA/CD, Ethernet, Hub, Switches and Bridges.

Wireless LAN: IEEE 802.11x standard.

Network and Transport Layer, Routing and Traffic Control, Flow and Congestion Control, Internetworking, Routers and Gateways, Internet IP, Transport Protocols, TCP/IP, ATM.
Network Security.

Reference Books:

6. Tanenbaum, Computer Networks, PHI.

(EE/T/412) Power System Protection and Switchgear


Reference Books:

1. The Art And Science Of Protective Relaying, by C.R.Mason, John Wiley
4. Power System Protection & Switchgear, by B.Ravindranath & M.Chander, Willey Eastern
8. Power System Protection, Vols.I, II, III & IV, by The Electricity Training Association,

(EE/T/413) ELECTRIC DRIVES

PART – I

Motor control components like contactors, relays, limit switches, etc., and example of motor control circuit like start-stop control, Star-Delta starter, forward-reverse change-over. Drive specifications. Basic terminology : base speed, speed ratio, constant torque drive, constant hp drive, etc. Four quadrant representation, dynamics of loading of motor with different types of mechanical load. Heating and cooling of motors, operating duty cycles. Choice of couplings and bearings.
Acceleration time, energy loss in starting. Effect of flywheels.

Regeneration in drives: Dynamic braking, regenerative braking, dc injection, plugging.

Electric Traction: General introduction and requirements, speed-time curve mechanics in train movement. DC and AC traction supplies. Current collectors. Traction motors.

Linear motors and magnetic levitation.

**PART – II**

Solid state control of dc motors – basic principles. Armature current control with constant flux and field weakening. Simple modeling of a separately excited dc motor. Drive schemes with armature voltage feedback, IR-compensation, and tacho feedback for both constant flux and field weakening.

Solid state control of induction motors – basic principles. V/f control with constant flux and field weakening. Simple modeling of an induction motor. Drive schemes with terminal voltage feedback and slip-compensation, also with tacho feedback for both constant flux and field weakening.


Realisation of the total converter system for ac and dc drives using choppers, Phase controlled rectifiers, Dual converters, Voltage Source Inverters (VSI), Current Source Inverters (CSI). Current Controlled VSI and Cyclo-converters. Basic operating principles and characteristics of the schemes.

Protection schemes for overall drive systems.

Power electronic controlled starting of dc and ac motors

**Reference Books:**

4. Power Semiconductor Controlled Drives: G.K. Dubey
5. Control of Electric machines: Irving L. Kosow
7. A First Course on Electrical drives: S.K. Pillai
8. Electric Motor Drives: R. Krishnan
9. Electric Drives: M. Chilikin

**EE/T/414) ELECTIVE PAPER– I**

**EE/T/414A) Digital Control Techniques**
**Introduction:** Introduction, Advantages and disadvantages of digital control, Configuration of the basic digital control scheme, Examples of practical digital control systems

**Review of Signal Conversion and Processing:** Comparative study of basic features of Continuous-time analog signal, Continuous-time quantized signal, Sampled-data signal, and Digital signal, Sampling, quantization and coding of an analog signal, Sample-and-Hold devices and their characteristics: Sampling duration, Sampling period, Acquisition time, Aperture time, Settling time, and Hold mode droop, Choosing the minimum and maximum sampling frequency, Concept of Hold operation and Zero Order Hold (ZOH), Transfer function of ZOH, Ideal sampled signal, Discrete-time vs. Digital Control Systems, Block diagram representation of the various signals associated at different subsystems of a digital control system.

**Modeling of Discrete-time Control Systems:** Time-domain model, State variable model, Difference equation model, Impulse response model; Transfer Function model, Pulse Transfer Function, Transfer Function of unit delay, Derivation of equivalent Pulse Transfer Function of Open Loop and Closed Loop system by Block Diagram reduction techniques.

**Time Domain Analysis and Design of Discrete-time Control System:** Time response calculation of discrete time control systems (open loop and closed loop) for standard test input using Pulse Transfer Function model, Mapping between s-plane and z-plane, Stability analysis of closed-loop systems in the z-plane, Method of testing absolute stability - The Jury stability test, Transient and Steady State response of discrete-time systems - Transient response specifications, Static error constants, Discrete-time Control system design by Root-Locus method.

**Frequency Domain Method of Analysis and Design of Discrete-time Systems:** Bilinear transformation, Bode diagram of discrete-time system, Gain margin and Phase margin, Design of compensators using Bode diagram for discrete-time system, Design on the W-plane and W'-plane.

**State-Space Analysis of Discrete Time Control System:** Discrete-time state-space equations, Canonical and Diagonal forms of state-space equations, Solving discrete-time state-space equations, Similarity transformation, Discretization of continuous-time state-space equations.

**Digital PID Controller Design:** Conventional design, Model based design.

**Controllability and Observability of Discrete Time Systems:** Definition of controllability for discrete-time system, Test for controllability for discrete-time system, Definition of observability for discrete-time system, Test for observability for discrete-time system.

**Pole Placement and Observer Design for Discrete Time Systems:** Design of a discrete-time state regulator by pole placement, Design of a discrete-time state feedback control system with reference input by pole placement, Design of full order and reduced order state observers, Compensator design by separation principle.

Reference Books:


(EE/T/414B) High Voltage Technique – I

Breakdown in gases, Townsend Mechanism, Paschen’s Law, Streamer breakdown, Breakdown under Surge Voltages, Different types of breakdown in solid dielectrics, Different types of breakdown in liquids, Partial discharge and its measurement techniques.


Analytical Method of Electric Field Analysis – Cylinder and Sphere in uniform field. Field Utilization factors for fields around cylinders and spheres.

Field Transformations. Techniques of electric stress control.

Reference Books:


(EE/T/414C) Special Electrical Machines & Drives

PART – I

Permanent magnet dc machines. PM synchronous motor and generator, 1-phase alternator, Linear Induction motors.

Energy efficient motors.

Induction regulators: Basic principles.

PART – II

Study of the doubly-fed slip-ring machine and the induction generator for synchronization to the grid.

*Microcontroller, DSP, PLC applications to motor drives.*

Introduction to Artificial Intelligence application to motor drives.

Feedback system components like tachogenerators, optical encoders, hall-effect sensors. Voltage and current sensing with dc and variable frequency supply.

**Reference Books:**

3. Electric Motor Drives: R. Krisnan
5. Electric machinery: Fitzgerald & Kingsley
6. Fractional & Sub-fractional Horsepower Motors: C. G. Veinott
7. Electrical machines: P.K. Mukherjee & S. Chakravorti
8. Permanent Magnet Motor Technology: J. Geras
9. Kenjo & Nagamori
10. Hendershoot & Miller
(EE/T/414D) **Advanced Instrumentation-I**


**Reference Books:**


(EE/T/414E) **Advanced Power Systems Analysis**


Short circuit study: Formulation of bus impedance matrix, digital computer solution of symmetrical and unsymmetrical faults.

Economic operation: Characteristics of generating units, generation scheduling neglecting transmission loss, scheduling problems considering transmission loss and its
solution by B-coefficient method, derivation of B-coefficients, unit commitment problem and its solution by dynamic programming, introduction to hydro-thermal scheduling problem.

Transient stability: Multimachine transient stability, its mathematical formulation and solution, representation of excitation system and its inclusion in stability studies, methods of improving transient stability. Introduction to dynamic stability:

Small perturbation model of single machine connected to infinite bus, analysis of voltage regulator action, cause of negative damping, preliminary concept of dynamic stability and power system stabilizer.


Reference Books:

4. Power Generation Operation And Control, by A.J.Wood & B.F.Wollenberg, John Willey

(EE/T/414F) Advanced Illumination Engineering

PART – I

Visual performance evaluation; external factors of vision-visual acuity, contrast sensitivity, time, luminance, colour; visual perception; assessment of visibility level; Biological factors of lighting-circadian system; optical radiation hazards. Illuminance calculation-illuminance as vector quantity, direct illuminance from point, linear, area sources, advanced methods of illuminance calculation, luminance, luminous exitance, non-planer illuminance – spherical, cylindrical etc., interreflected illuminance.

Photometry- types of detectors–characteristics, figures of merit etc.; detection elements- filters, cosine diffuser, imaging optics. Photometric measurements – C-Gama and B-Beta photometry; understanding of luminaire photometric test report; luminance, colour temperature, sources of errors and correction, calibration and calibration report.
Colorimetry – visual basis of colorimetry, source colour & object colour. CIE chromaticity – XYZ and UCS colour space, source and object colour specification, dominant wavelength, purity, Grassmann’s law of colour mixing, CIE standard source and illuminant. Munsell colour system; colorimetric instrument – light source colorimetry and colorimetry of materials; colour rendering index-its measurement; metamerism.

PART – II
Lamp materials- filament, glass, ceramics, gases, phosphors and other metals & nonmetals; theory of gas discharge phenomena; lamp design considerations; characteristics of low & high pressure mercury-vapour & sodium-vapour lamps; modern energy saving lamps - comparative study; coloured LED & white LED – features and characteristics, features and applications; LASER – characteristics, features and applications. Optical fiber – its construction as light guide, features and application.
Ballasts & ignitors for different discharge lamps; design consideration of electromagnetic and electronic ballast for TL lamps; ballast materials.
Luminaire – design considerations, optical control schemes, design procedure of reflecting and refracting type of luminaire, testing of luminaire, Ingress Protection (IP) code, Luminaire standard – BIS recommendation.
Lighting controls:- different control equipment- on/off switch, simple automatic switches, photocell, occupancy sensor, timer, lighting contactors, dimmer, low voltage relays; communication links-line and low voltage hardware; different control strategies.

Reference Books:
1. Human Factors in Lighting – P R Boyce
2. Lighting-D.C..Pritchard
3. Lighting for energy efficient luminous environments- Ronald N.Helms & M Clay Belcher.
5. Illumination Engineering: From Edison lamp to the LASER – J.B.Murdoch,
7. Lighting Control Hand book – Craig Dilovie

(EE/S/411) E.E. LABORATORY – V
Selected Experiments in Electrical Machines, Control Systems, Power Systems, High Voltage and Measurements & Instrumentation Laboratories.

(EE/S/412) ELECTIVE PROJECT AND COMPUTATION – I

(EE/S/413) SEMINAR – I

(EE/S/414) ELECTRICAL MACHINE DESIGN – III

Design of 3-phase Induction Motor and 1-phase Induction Motor.

Reference Books:


(EE/S/415) GENERAL VIVA VOCE

Based on the theory and sessional subjects covered under B. E. E. Programme.

Theory – 14 pds. Sessional- 12 pds. TOTAL- 26 pds.

VIII. Fourth Year – Second Semester

(EE/Gen/T/421) Economics And Industrial Management

PART I

Nature and significance of economics; Engineering economics and its importance.

Demand and Supply analysis: Laws of demand and supply; elasticity of demand and supply; demand forecasting.

Markets: its meaning and different types; Price-output determination under different market forms.

Money and its fluctuations; inflation.

Banking system in India; role of commercial banks; Reserve Bank of India and its functions.

Sources of Public Revenue-Principles of taxation.
Industrial cost and their classifications; preparation of cost sheet.

Economic efficiency; Depreciation and replacement studies.

Investment decision; present worth, annual worth, and Rate of return methods, Payback time.


Cost Accounting and Finance: Financial control ratio analysis and their interpretation for industrial control, Budget and budgetary control.

**PART II**


Types of business ownership, means of finance and business combinations, organization structures, committee organization, authority and responsibility, duty and span of control. Plant location, plant layout, tools and techniques of plant layout, materials handling arrangements, vendor management.

Product development. Functions of production, planning and control, production forecasting, production scheduling and network techniques, Gantt chart, CPM, PERT etc.

Work study, job evaluation and merit rating; purchase system and inventory control. Inspection and quality control of systems, statistical quality control, maintenance and replacement policies for machine and equipments; decision making theories, breakeven analysis cost benefit analysis, evaluation of financial and managerial efficiencies.


**Reference Books:**

1. Production and operations management: S.N.Chari
2. "Industrial Management" by: Basu & Majmundar (Birla Pub., Newdelhi)
3. "Quantitative techniques in management" by: N.D.Vohra (Tata Mcgraw Hill)
4. "Production systems analysis and control" by: Riggs
5. "Works organization and management by: Basu, Sahoo & Dutta."
(EE/T/422) ELECTIVE PAPER– II

(EE/T/422A) Advanced Control Theory

Part - I

Part – II

Reference Books:

(EE/T/422B) High Voltage Technique – II


Insulation Coordination: Insulation level (BIL & SIL), Statistical approach to insulation coordination, Correlation between insulation and protection levels. Laboratory high voltage testing procedure: Power frequency HV testing, Lightning impulse voltage testing. Transient Analysis: Electromagnetic transients by EMTP, Ferroresonance, Impulse Voltage distribution in transformer windings.

Reference Books:
1. High Voltage Engineering Edited by Alston
2. Insulation Coordination in high voltage electric power systems by W. Diesendorf
3. An introduction to high voltage experimental technique by Dieter Kind
4. Extra high voltage ac transmission engineering by R.D. Begamudre

(EE/T/422C) Advanced Electrical Machine Modelling & Analysis

PART – I

Energy conversion principle in single excited magnetic system and multiply excited magnetic system. Dynamic equation of magnetic systems – analytic techniques.

Space Vectors and its application to the analysis of electric machines, specially of induction motors.

Transient analysis of dc and ac Machines.

Motor behavior under asymmetrical supply voltages. Analysis of 3-phase induction motor with ac phase controlled supply.

Application of Simulation tools to machine analysis.

PART – II

Generalised theory of machines.

Principle of Vector decoupled control.


Reference Books:

1. Power Electronic Control of AC Motors :J.M.D. Murphy, F.G. Turnbull
2. Modern Power Electronics and AC Drives: B.K. Bose
3. Analysis of Electric Machinery and Drive systems: Krause, Wasynezuk & Sudhoff
4. Transient Phenomena in Electrical machines: Paul K. Kovacs
5. Electric machinery: Fitzgerald & Kingsley

(EE/T/422D) **Advanced Instrumentation-II**

Introduction to non-destructive testing (NDT). NDT methods – liquid penetrant (LP) testing, eddy current (ET) testing, magnetic particle testing (MT), radiographic testing (RT), acoustic emission testing (AET), ultrasonic testing (UT). Applications.


Electrical tomographic techniques: introduction to EIT, concepts of ERT, ECT and eddy current tomography.

State-space design methods: concepts of controllability and observability, concepts of duality. Pole placement controllers. State observers.


Introduction to model predictive control (MPC) and internal model control (IMC).


Reference Books:

1. Digital Signal Processing: Proakis and Manolakis
2. Digital Image Processing: Gonzalez and Woods
3. Industrial Digital Control: Warwick and Rees
4. Modern Control Engineering: Ogata
5. Random Processes and Kalman Filtering: Brown and Hwang
8. An Introduction to Micro-electromechanical Systems Engineering: Maluf and Williams
9. An Introduction to Fuzzy Control: Driankov, Hellendoorn, and Reinfrank
10. Systems and Control: Stanislaw Zak

(EE/T/422E) Advanced Topics In Power Systems

HVDC Operation and control : Review of HVDC converter operation, CIA. CC and CEA control characteristics.

Introduction to FACTS – Brief description of various FACTS devices and their principle of operation, role of FACTS in active and reactive power control.


Computer aided operation and control of Power Systems--- Concept of Energy Control Center, introduction to SCADA and EMS. Introduction to state estimation and security analysis.
Power system operation under deregulated environment.

Reference Books:

2. High Voltage Direct Current Transmission, J.Arrillaga, Peter Peregrinus Ltd.
5. Direct Current Transmission, by E.W.Kimbark, Wiley Interscience
10. Understanding Power Quality Problems by Math H. J. Bolen

(EE/T/422F) Advanced Lighting Design

PART – I

Indoor lighting– zonal cavity method for general lighting design - CU determination for zonal cavities and different shaped ceilings. Bureau of Indian Standard (BIS)/National Lighting Code (NLC) for different indoor applications; selection criteria of lamps and luminaire, design considerations and design procedure.

Daylighting – characteristics and features of daylight; sky models – Indian clear sky, CIE standard general skies; daylighting concepts-sidelighting, toplighting; window design formula by Daylight Factor method; physical scale modeling of daylighting system, daylight linked artificial lighting.

Quality and quantity assessment of lighting systems – BIS recommendation of lux level; factors affecting the required quantity; evaluating the quantity of illuminance; procedures of field measurements; quality of illuminance – discomfort & disability glare – evaluation method, veiling reflection, Visual Comfort Probability (VCP).

Emergency lighting:– escape lighting, standby lighting; maintained & non-maintained lighting systems – transport lighting.

PART – II

Roadlighting – road classifications according to BIS, pole arrangements, terminology, lamp & luminaire selection, different design procedures – beam lumen method, point-by-
point method, isolux diagram method; tunnel lighting; NLC recommendations; glare assessment-Threshold Increment, Glare Control Mark.
Floodlighting- selection of floodlights-NEMA classifications, design procedure; mast/pole selection and layout; lamp & luminaire selection and aiming. NLC, CIE and IESNA recommendations; glare assessment-GR,
Sportslighting- special lighting requirements for football, cricket, badminton ground – NLC, CIE recommendations, lamp & luminaire selection, design considerations and design procedure.
Computer application in lighting design – indoor general lighting design, roadlighting design, area lighting design, plotting of isolux diagram.
Lighting energy management and economics – lighting power budget; lighting power limit; evaluation of existing system; retrofitting of lighting systems; different options for consideration; components of cost and savings; simple payback analysis; life cycle cost analysis.

Reference Books:

3. Lighting for energy efficient luminous environments- Ronald N.Helms & M Clay Belcher.
5. Interior Lighting – J B de Boer and D Fischer
6. Road lighting – W J M van Bommel & J B de Boer
7. Energy Management in Illumination Systems – Kao Chen

(EE/T/423) SPECIAL PAPER - I

(EE/T/423A) Nonlinear And Optimal Control

Part I: Nonlinear Control


Part II: Optimal Control


Tracking Control Scheme: The Problem of Achieving a Desired Trajectory, Finite-Time Results, Infinite-Time Results.


Reference Books:

2. H. K. Khalil, Nonlinear Systems, PH.
4. Brian D. O. Anderson and John B. Moore, Optimal Control: Linear Quadratic Methods, PH.
5. Donald E. Kirk, Optimal Control theory – An Introduction.

(EE/T/423B) Condition Monitoring Of Electrical System

Potential cost benefits of plants, Remote monitoring of Electrical Plant, High voltage maintenance and safety, Plant insulation condition monitoring, Machines protection system, Plant monitoring by using Thermography, hydro electric power plant – on line condition system, Operation and maintenance of wind farms, condition monitoring through Non destructive testing on plant.

Maintenance Strategies: corrective maintenance, Time-based maintenance, condition based maintenance, Reliability centered maintenance.

Insulation Diagnostic Tests: Insulation resistance Test (IR), Polarization Index Test (PI), Step Voltage test, Surge Voltage Test, Power Frequency Over- Voltage Test, Partial discharge test.

Condition Monitoring of Transformers: Dissolved gas Analysis, Degree of Polarization Test, Furan Analysis. Dielectric Response Techniques in Time-Domain: Polarization and Depolarization current measurement (PDC), Recovery voltage measurement (RVM). Dielectric response Techniques in Frequency- Domain: Frequency domain spectroscopy (FDS), Sweep frequency response analysis (SFRA).

Condition Monitoring of Switchgears: Contact monitoring, Thermography, Vibration analysis, SF6 gas monitoring, Accessories monitoring.

**Reference Books:**

1. Condition Monitoring of Rotating Electrical Machines:- Peter Tavner, Li Ran, Jin man & Haward Shedding
3. Hand Book of Condition Monitoring Techniques and Methodology – A Davis.

**(EE/T/423C) Reliability Engineering**

Reliability Function; Repairable and Non-repairable Systems; Markov modeling; Two state models; Series , parallel and composite systems ; MTTF, MTTR, MTBF.
Generating unit unavailability; Capacity outage probability tables; Comparison of deterministic and probabilistic criteria; Recursive algorithm for capacity model building; Recursive algorithm for unit removal.

Loss of load indices (LOLE computation); Loss of energy indices (LOEE and EIR computation).

Frequency and duration method for generating capacity evaluation; State space diagram of frequency and duration method.

Reliability of Substation- Active and passive failures; Stuck condition of breakers; Effect of failure modes; Simulation of failure modes; Evaluation of reliability indices.

Reliability of Distribution systems - Customer oriented indices; Load and energy oriented indices; Application to radial systems; Effect of lateral distribution protection; Effect of disconnectors; Effect of protection failures; Method of network reduction; Temporary and transient outages; Inclusion of weather effects; Stochastic approach.


Life testing: Sequential testing (type-I censored data), Simultaneous testing (type-II censored data).


Failure mechanisms. Accelerated life testing of electronic components, reliability prediction.

Reliability of Measurement Systems.

Software Reliability - Software failure modes; Structured programs; Program checking & testing; Software reliability statistics.

**Reference Books:**


(EE/T/423D) Energy Systems

Energy Resources in general, present scenario, Energy consumption and acts, Environmental aspects of Thermal, Nuclear and hydroelectric power generation, types of emission from various sectors, co-relation between emission & pollution. Kyoto protocol, and carbon credit etc. Energy audit: primary and detail auditing.

Energy management: Demand side management (DSM) and Supply side management (SSM), Supply side management through energy price control, Smart Grid – functions, features and technologies. The role of Reactive power management.

Distributed generation (DG) and Microgrids: - features of distributed generations, technical issues of DG connection at distribution voltage level. Composition of Microgrid.

Renewable energy resources: Solar- solar thermal, solar PV, wind energy- prospects and status in national and global context, principles of wind energy conversion, wind monitoring system, VAWT and HAWT, selection of site for WTGS. Geothermal, Tidal, Bioenergy- Biomass and bio gas with gasifiers etc. fuel cell. Mini and micro hydel power plant, micro turbine.

Energy storage and conservation:- Types and methods of energy storage, Energy storage setups like Chemical, Thermal, Magnetic, fly wheel storage etc. Energy conservation - Concept of co-generation, combined heat and power (CHP).

Reference Books:

5. Demand Side Management planning - Gelling C W et al. Fairmount Press, Lilbum, U S A.

(EE/T/424) SPECIAL PAPER – II

(EE/T/424A) Advanced Computing Techniques


Reference Books:

1. Neural Networks – A Comprehensive Foundation, by Simon Haykin, Pearson education

(EE/T/424B) Introduction to Nano-Bio Technology


Semiconductor and Nanoelectronics devices: overview, Moore’s Law and silicon devices, Molecular computing, Quantum effects / tunneling, Quantum devices and computing.

Nano Fabrication Techniques: Bottom-up and top-down approaches, MEMS fabrication & integration, Self-assembly, DNA arrays and templating.

Nanobiotechnology: Nano-Bio convergence, Applications of DNA microarrays-GeneChip, SNP, and protein arrays; Application of Self assembly-Protein assembly, DNA assembly / templating; Digital cells- Insilico devices, Genetic circuits. DNA computing, Synthetic Biology, Bioelectronic circuits & sensors.

Applications: Virus Detection, Radiation/Chemotherapy, Neurological functions of the brain, Biomedical engineering research.

Reference Books:


(EE/T/424C) Principles Of Software Engineering

Part I

The Product: Introduction, Definition of Software, The evolving role of Software, Software characteristics, Software components, Software applications, Software myths, Software crisis, Summary


Part II


Reference Books

4. S. Goldsmith

(EE/T/424D) Bio-Medical Instrumentation

Components of Man-Instrument system

Measurement of Electrical potentials and Magnetic Fields from the Body surface. Electrodes; Half-Cell Potential; Equivalent Circuits

Biopotential amplifiers; Medical isolation amplifiers; Driven-Leg ECG amplifiers

The ECG: Electrode placement; Vector cardiography; Feature extraction.

The EMG. The EEG; Event related potentials. Other body surface potentials; EOG; Electroretinogram.


Plethysmography; volume displacement; impedance. Pulmonary Function Tests.

Ultrasound - Doppler U/S for blood and tissue velocity measurements.

Stimulation of excitable tissues; Cardiac pacing and defibrillation.

Biometrics

Biotelemetry


Tomographic Techniques: X-Ray/ CT scan, MRI, Beta-gamma scanning.

Heart-lung machine.

Dialyzer.
Bioelectric Signal Processing.

**Reference Books:**

1. Introduction to Instrumentation and Measurements; Second Edition; Robert B Northrop; Taylor and Francis;
2. Noninvasive Instrumentation and Measurement in Medical Diagnosis; Robert N. Northrop; CRC press.
4. Handbook of Biomedical Instrumentation, R.S. Khanpur

(EE/S/421) **E.E. LABORATORY – VI**

Selected Experiments in Electrical Machines, Control Systems, Power Systems, High Voltage and Measurements & Instrumentation Laboratories.

(EE/S/422) **ELECTIVE PROJECT AND COMPUTATION – II**

(EE/S/423) **SEMINAR – II**

(EE/S/424) **POWER ELECTRONICS DESIGN**


**Reference Books:**


**Theory – 14 pds. Sessional- 12 pds. TOTAL- 26 pds.**