

Syllabus and Scheme

B.Tech. in Electrical Engineering

(For students admitted from 2012 to 2016)

SEMESTER-I & II

Scheme of Teaching & Examination for I year B.Tech. I Semester
Effective from the Session: 2012 – 2013
(Common to all branches of Engineering)

Sub Code	Subject	Number of Teaching Hours			Duration of Theory Paper (Hours)	Marks Allocation				
		L	T	P		Theory	Term Test	Sessional	Prac. Exam	Total
101	Communicative English	3	1	-	3	80	20			100
102	Engineering Mathematics-I	3	1	-	3	80	20			100
103	Engineering Physics-I	3	1	-	3	80	20			100
104	Engineering Chemistry	3	1	-	3	80	20			100
105	Basic Electrical & Electronics Engineering	3	-	-	3	80	20			100
Total		15	04	-	-	400	100			500
106	Engineering Physics Lab-I	-	-	2		-		45	30	75
107	Engineering Chemistry Lab			2				45	30	75
108	Electrical & Electronics Lab	-	-	2		-		60	40	100
109	Practical Geometry	-	-	3				60	40	100
110	Workshop Practice	-	-	2				60	40	100
111	Discipline & Extra curricular Activities	-	-	-				50	-	50
Grand Total		15	04	11	-	400	100	320	180	1000

(Total 30 periods per week)

Scheme of Teaching & Examination for I year B.Tech II Semester
Effective from the Session: 2012 – 2013
(Common to all branches of Engineering)

Sub Code	Subject	Number of Teaching Hours Per Week			Duration of theory Paper (Hours)	Marks Allocation				
		L	T	P		Theory	Term Test	Sessi onal	Prac. Exam	Total
201	Communication Techniques	2	-	-	3	80	20			100
202	Engineering Mathematics-II	3	1	-	3	80	20			100
203	Engineering Physics-II	2	1	-	3	80	20			100
204	Chemistry & Environmental Engineering	3	1	-	3	80	20			100
205	Engineering Mechanics	3	1	-	3	80	20			100
206	Fundamentals of Computer Programming	3	-	-	3	80	20			100
Total		16	04	-	-	480	120			600
207	Engineering Physics Lab-II	-	-	2		-		30	20	50
208	Chemistry & Environmental Engineering Lab	-	-	2		-		30	20	50
209	Computer programming lab	-	-	2				45	30	75
210	Machine Drawing	-	-	3		-		60	40	100
211	Communication Technique Lab	-	-	2		-		45	30	75
212	Discipline & Extra Curricular Activities	-	-	-	-	-		50	-	50
Grand Total		16	04	11	-	480	120	260	140	1000

(Total 31 periods per week)

L = Lecture, **T** = Tutorial, **P** = Practical

101 COMMUNICATIVE ENGLISH

Unit 1

Grammar

1. Tenses
2. Passive Voice
3. Indirect Speech
4. Conditional Sentences
5. Modal Verbs

Unit 2

Composition

1. Dialogue Writing
2. Paragraph and Precis Writing
3. Report, its importance and Report Writing

Unit 3

Short Stories

1. The Luncheon: W.S. Maugham
2. How Much Land Does a Man Need?: Leo Tolstoy
3. The Last Leaf: O. Henry

Unit 4

Essays

1. On the Rule of the Road: A. G. Gardiner
2. The Gandhian Outlook: S. Radhakrishnan
3. Our Own Civilisation: C.E.M. Joad

Unit 5

Poems

1. The Unknown Citizen: W. H. Auden
2. The Character of A Happy Life: Sir Henry Wotton
3. No Men are Foreign: James Kirkup
4. If : Rudyard Kipling

Suggested Readings

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma & Binod Mishra, PHI Learning Pvt. Ltd.
2. English for Engineers: Made Easy, Aeda Abidi & Ritu Chaudhary, Cengage Learning, (New Delhi)
3. A Practical Course for Developing Writing Skills in English, J.K. Gangal, PHI Learning Pvt. Ltd., New Delhi.
4. Intermediate Grammar, Usage and Composition, Tickoo, A. E. Subramaniam & P. R. Subramaniam, Orient Longman (New Delhi)
5. The Written Word , Vandana R. Singh, Oxford University Press (New Delhi)

6. The Great Short Stories edited by D.C. Datta, Ram Narain Lal Publishers (Allahabad)
7. Professional Communication, Kavita Tyagi & Padma Misra, PHI Learning Pvt. Ltd., New Delhi.
8. “Learn Correct English: Grammar, Usage and Composition” by Shiv K. Kumar & Hemalatha Nagarajan, Pearson (New Delhi).
9. “Current English Grammar and Usage with Composition” by R.P. Sinha, Oxford University Press (New Delhi).
10. “Grammar of the Modern English Language”, by Sukhdev Singh & Balbir Singh, Foundation Books (New Delhi).

102 ENGINEERING MATHEMATICS-I

Unit 1

Differential Calculus: Asymptotes (Cartesian Coordinates Only), Curvature (Cartesian Coordinates Only), Concavity, Convexity and Point of Inflexion (Cartesian Coordinates Only), Curve Tracing (Cartesian and Standard Polar Curves-Cardioids, Lemniscates of Bernoulli, Limacon, Equiangular Spiral).

Unit 2

Differential Calculus: Partial Differentiation, Euler’s Theorem on Homogeneous Functions, Approximate Calculations, Maxima & Minima of Two and More Independent Variables, Lagrange’s Method of Multipliers.

Unit 3

Integral Calculus: Surface and Volumes of Solids of Revolution, Double Integral, Double Integral by changing into polar form, Areas & Volumes by Double Integration, Change of Order of Integration, Beta Function and Gamma Function (Simple Properties).

Unit 4

Differential Equations: Differential Equations of First Order and First Degree - Linear Form, Reducible to Linear form, Exact Form, Reducible to Exact Form, Linear Differential Equations of Higher Order with Constant Coefficients Only.

Unit 5

Differential Equations: Second Order Ordinary Differential Equations with Variable Coefficients, Homogeneous and Exact Forms, Change of Dependent Variable, Change of Independent Variable, Method of Variation of Parameters.

Suggested Readings

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley 9th Edition.
2. Calculus and Analytical Geometry, Thomas and Finney, Narosa Publishing House. New Delhi.
3. A Text Book of Differential Equations, M. Ray and Chaturvedi, Students Friends & Co. Publisher, Agra.
4. Higher Engineering Mathematics, B.V. Ramana, Tata McGraw Hill.

5. Thomas Calculus, Maurice D. Weir, Joel Hass and others, Pearson, 11th Edition.

103 ENGINEERING PHYSICS-I

Unit 1

Interference of light

Michelson's Interferometer: Production of circular & straight line fringes, Determination of wavelength of light, Determination of wavelength separation of two nearby wavelengths.

Newton's rings and measurement of wavelength of light.

Optical technology: Elementary idea of anti-reflection coating and interference filters.

Unit 2

Polarization of light

Plane circular and elliptically polarized light on the basis of electric (light) vector, Malus law.

Double Refraction: Qualitative description of double refraction phase retardation plates, quarter and half wave plates, construction, working and use of these in production and detection of circularly and elliptically polarized light.

Optical Activity: Optical activity and laws of optical rotation, Specific rotation and its measurement using half-shade and bi-quartz devices.

Unit 3

Diffraction of light

Single slit diffraction: Quantitative description of single slit, position of maxima / minima and width of central maximum, intensity variation.

Diffraction Grating: Construction and theory, Formation of spectrum by plane transmission grating, Determination of wavelength of light using plane transmission grating.

Resolving power: Geometrical & Spectral, Raleigh criterion, Resolving power of diffraction grating and telescope.

Unit 4

Elements of Material Science

Bonding in Solids: Covalent bonding and Metallic bonding.

Classification of Solids as Insulators, Semiconductors and Conductors.

Semiconductors: Conductivity in Semiconductors, Determination of Energy gap of Semiconductor.

X-Ray diffraction and Bragg's Law.

Hall Effect: Theory, Hall Coefficient and applications.

Unit 5

Special Theory of Relativity

Postulates of special theory of relativity, Lorentz transformations, relativity of length, mass and time.

Relativistic velocity addition and mass-energy relation, Relativistic Energy and momentum.

Suggested Readings

1. Fundamental of Optics, Jenkins and White, Fourth Edition, McGraw Hill.
2. Optics, Ajoy Ghatak, Third Edition, Tata McGraw Hill.
3. Concept of Modern Physics, A. Baiser, Fifth Edition, McGraw Hill.
4. Modern Physics, J. Morrison, Edition 2011, Elsevier.
5. Elements of Material Science and Engineering, Van Vlack, Sixth Edition, Pearson.

104 ENGINEERING CHEMISTRY

Unit 1

General Aspects of Fuel: Organic fuels, Origin, classification and general aspects of fossil fuels. Solid fuels, Coal, carbonization of coal, manufacturing of coke by Beehive oven and by product oven method. Liquid fuels, Composition of petroleum, advantages and refining of petroleum. Cracking, reforming, polymerization and isomerization of refinery products. Synthetic petrol, Bergius and Fischer Tropsch process. Knocking, octane number and anti-knocking agents. Gaseous fuels, Advantages, manufacturing, composition and calorific value of coal, gas and oil gas.

Unit 2

Fuels Analyses: Ultimate and proximate analysis of coal, Determination of calorific value of solid and gaseous fuels by bomb and Junker's Calorimeter respectively. Calculations of calorific value based on Dulong's formula. Combustion, requirement of oxygen/ air in combustion process. Flue gas analysis by Orsat's apparatus and its significance.

Unit 3

Polymers: Different methods of classification, basic ideas of polymerization mechanisms. Elastomers: Natural rubber, vulcanization, Synthetic Rubbers viz. Buna-S, Buna-N, Butyl and neoprene rubbers.

New Engineering Materials: Fullerenes: Introduction, properties, preparation and uses. Organic Electronic Materials (including conducting polymers- poly (p-phenylene), polythiophenes, Polyphenylene, vinylenes, polypyroles, polyaniline).

Unit 4

Cement: Definition, Composition, basic constituents and their significance, Manufacturing of Portland cement by Rotary Kiln Technology, Chemistry of setting and hardening of cement and role of gypsum.

Glass: Definition, Properties, Manufacturing of glass and importance of annealing in glass making, Types of silicate glasses and their commercial uses, Optical fiber grade glass.

Unit 5

Refractory: Definition, classification, properties, Requisites of good refractory and manufacturing of refractory. Preparation of Silica and fire clay refractory with their uses. Seger's (Pyrometric) Cone Test and RUL Test

Lubricants: Introduction, classification and uses of lubricants. Types of lubrication. Viscosity & viscosity index, flash and fire point, cloud and pour point, steam emulsification number, precipitation number and neutralization number.

Suggested Readings

1. The Chemistry and Technology of Coal, by J G Speigh, CRC Press
2. The Chemistry and Technology of Petroleum, by J G Speigh, CRC Press
3. Polymer Chemistry: An Introduction, Malcolm P. Stevens, Oxford University Press
4. Solid State Chemistry and Its Applications, Anthony R West, John Wiley & Sons
5. Lubricants and Lubrications, Theo Mang, Wilfeied, Wiley-VCH
6. Hand Book of Conjugated Polymers, Tejre A Skotheim and J. R. Reynolds, CRC Press

105 BASIC ELECTRICAL & ELECTRONICS ENGINEERING**Unit 1**

Basic Concepts of Electrical Engineering: Electric Current, Electromotive force, Electric Power, Ohm's Law, Basic Circuit Components, Faraday's Law of Electromagnetic Induction, Lenz's Law, Kirchhoff's laws, Network Sources, Resistive Networks, Series-Parallel Circuits, Node Voltage Method, Mesh Current Method, Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.

Unit 2

Alternating Quantities: Introduction, Generation of AC Voltages, Root Mean Square and Average Value of Alternating Currents and Voltages, Form Factor and Peak Factor, Phasor Representation of Alternating Quantities, Single Phase RLC Circuits, Introduction to 3-Phase AC System.

Unit 3

Rotating Electrical Machines; DC Machines: Principle of Operation of DC Machine as Motor and Generator, EMF Equation, Applications of DC Machines.

AC Machines: Principle of Operation of 3-Phase Induction Motor, 3-Phase Synchronous Motor and 3- Phase Synchronous Generator (Alternator), Applications of AC Machines.

Unit 4

Basic Electronics: Conduction in Semiconductors, Conduction Properties of Semiconductor Diodes, Behaviour of the PN Junction, PN Junction Diode, Zener Diode, Photovoltaic Cell, Rectifiers, L, C, & L-C filters, Bipolar Junction Transistor, Field Effect Transistor, Transistor as an Amplifier.

Digital Electronics: Boolean algebra, Binary System, Logic Gates and Their Truth Tables.

Unit 5

Communication Systems: Introduction, IEEE Spectrum for Communication Systems, Types of Communication, Amplitude and frequency Modulation.

Instrumentation : Introduction to Transducers: Thermocouple, RTD, Strain Gauges, Load Cell and Bimetallic Strip.

Introduction and classification of ICs.

Suggested Readings

1. Electrical and Electronic Technology by Edward Hughes et al, Pearson Publication

2. Basic Electrical & Electronics Engineering by V. Jagathesan, K. Vinod Kumar & R. Saravan Kumar, Wiley India.
3. Basic Electrical & Electronics Engineering by Van Valkenburge, Cengage learning Indian Edition
4. Basic Electrical and Electronics Engineering by Muthusubramaniam, TMH
5. Fundamentals of Electrical Engineering by Leonard S. Bobrow, Oxford University Press
6. Fundamentals of Electrical and Electronics Engineering by Ghosh, Smarajit, PHI India
7. Basic Electrical & Electronics Engineering by Ravish Singh, TMH
8. Basic Electronics Engineering by Vijay Baru et al, Dream Tech, New Delhi

106 ENGINEERING PHYSICS LAB-I

1. To determine the wave length of monochromatic light with the help of Fresnel's biprism.
2. To determine the wave length of sodium light by Newton's Ring.
3. To determine the specific rotation of Glucose (Sugar) solution using a polarimeter.
4. To determine the wave length of prominent lines of mercury by plane diffraction grating with the help of spectrometer.
5. To convert a Galvanometer in to an ammeter of range 1.5 amp. and calibrate it.
6. To convert a Galvanometer in to a voltmeter of range 1.5 volt and calibrate it.
7. To study the variation of a semiconductor resistance with temperature and hence determine the Band Gap of the semiconductor in the form of reverse biased P-N junction diode.
8. To study the variation of thermo e.m.f. of iron copper thermo couple with temperature.
9. To determine coherent length and coherent time of laser using He-Ne Laser.

107 ENGINEERING CHEMISTRY LAB

1. Proximate analysis of solid fuel.
2. Experiments based on Bomb Calorimeter.
3. To determine the strength of Ferrous Ammonium sulphate solution with the help of $K_2Cr_2O_7$ solution.
4. To determine the strength of $CuSO_4$ solution with the help of hypo solution.
5. To determine the strength of NaOH and Na_2CO_3 in a given alkali mixture.
6. Determination of Na/K/Ca by flame photometer in a given sample.
7. Determination of turbidity in a given sample.
8. To determine the flash and fire point of a given lubricating oil.
9. To determine the viscosity of a given lubricating oil by Redwood viscometer.
10. To determine cloud and pour point of a given oil.

108 ELECTRICAL AND ELECTRONICS LAB

Electrical lab

1. Assemble house wiring including earthing for 1-phase energy meter, MCB, ceiling fan, tube light, three pin socket and a lamp operated from two different positions. Basic functional study of components used in house wiring.
2. Prepare the connection of ceiling fan along with the regulator and vary the speed.
3. Prepare the connection of single phase induction motor through 1-Phase Auto-transformer and vary the speed.
4. Prepare the connection of three phase squirrel cage induction motor through 3-Phase Auto-transformer and vary the speed.
5. Prepare the connection of Fluorescent Lamp, Sodium Vapour and Halogen Lamp and measure voltage, current and power in the circuit.

Electronics lab

1. Identification, testing and application of Resistors, Inductors, Capacitors, PN-Diode. Zener Diode, LED, LCD, BJT, Photo Diode, Photo Transistor, Analog/Digital Multi- Metres and Function/Signal Generator.
2. Measure the frequency, voltage, current with the help of CRO.
3. Assemble the single phase half wave and full wave bridge rectifier & the analyse effect of L, C and L-C filters in rectifiers.
4. Study the BJT amplifier in common emitter configuration. Measure voltage gain plot gain frequency response and calculate its bandwidth.
5. Verify the truth table of AND, OR, NOT, NOR and NAND gates.

109 PRACTICAL GEOMETRY

1. (a) Lines, Lettering & Dimension (Sketch Book)
(b) Scale-representative Fraction, Plan scale, Diagonal Scale, Vernier scales (In sheet) comparative Scale, & scale of chords (Sketch Book)
2. (a) Conic Section:-
Construction of Ellipse, Parabola & Hyperbola by different methods (In sheet)
(b) Engineering curves:-
Construction of cycloid, Epicycloids, Hypocycloid and Involute (In sheet) Archimedean and Logarithmic spiral, (Sketch book)
3. (a) Type of Projection, Orthographic Projection: First Angle and third Angle Projection (Sketch Book)
(b) Projection of Points (Sketch Book)
(c) Projection of Straight lines, different position of Straight lines, methods for determining True length, true inclinations and Traces of straight lines (Four problems in sheet and three problems in (Sketch Book)
- (d) Projection of Planes: Different positions of Plane lamina like.:- Regular polygon, circle three of planes (Four problems in Drawing sheet and three problems in Sketch Book.)
4. (a) Projection of Solids:- Projection of right and regular Polyhedron, Prisms, Pyramids and cone (Four Problem in Drawing sheet and there in Sketch Book.)

- (b) Section of Solids:- Projection of Frustum of a cone and pyramid, Projection of Truncated Solids (like Prism, Pyramid, Cylinder and Cone) in different positions.
5. (a) Development of Surfaces:- Parallel line and Radial line method for right, regular solids
- (b) Isometric Projections:- Isometric Scales, Isometric Axes, Isometric Projection of Solids.

Suggested Readings

1. Engineering Drawing Geometrical Drawing - P.S.Gill, S.K.Katara & Sons.
2. Engineering Drawing, Dhanarajay A Jolhe ,Tata McGraw Hill.
3. Engineering Drawing, Basant Agarwal & CM Agarwal ,Tata McGraw Hill.
4. Engineering Drawing, N.D.Bhatt, Charotar Publishing House Pvt. Ltd.

110 WORKSHOP PRACTICE

Carpentry Shop

1. T – Lap joint
2. Bridle joint

Foundry Shop

1. Mould of any pattern
2. Casting of any simple pattern

Welding Shop

1. Gas welding practice by students on mild steel flat
2. Lap joint by gas welding
3. MMA welding practice by students
4. Square butt joint by MMA welding
5. Lap joint by MMA welding
6. Demonstration of brazing

Machine Shop Practice

1. Job on lathe with one step turning and chamfering operations
2. Job on shaper for finishing two sides of a job
3. Drilling two holes of size 5 and 12 mm diameter on job used / to be used for shaping
4. Grinding a corner of above job on bench grinder

Fitting and Smithy Shop

1. Finishing of two sides of a square piece by filing
2. Tin smithy for making mechanical joint and soldering of joint
3. To cut a square notch using hacksaw and to drill three holes on PCD and tapping

Suggested Readings

1. Mechanical Workshop Practice, K.C. John, PHI Learning New Delhi.
2. Elements of Workshop Technology Hajra & Choudhary,Media Promoters &Publisher.
3. Workshop Technology , W.A.J.Chapman, CBS Publisher & Distributor New Delhi.

111 DISCIPLINE & EXTRA CURRICULAR ACTIVITIES (DECA)

Component – A

Discipline:

25 Marks

The marks shall be deducted from this component for those who shall involve themselves in indiscipline/undesirable/Ragging activities or in case of penalty of marks imposed by Standing Disciplinary Committee (SDC) and approved by Head of the Institution concerned subject to a maximum of 25 marks.

Component – B Extra Curricular Activities: 25 Marks

Marks shall be awarded for the participation of students in various Extra Curricular Activities organised by the respective institutions as per the following, subject to a maximum of 25 marks. In case student does not participate in any of the Extra Curricular Activities, he/ she shall be awarded zero(0) marks in DECA - Component B.

- (i) National Cadet Corps (NCC).
- (ii) National Service Scheme (NSS)
- (iii) Scouts & Guide
- (iv) Sports Activities
- (v) Literary Activities & model
- (vi) Cultural Activities
- (vii) Paper Presentation/ Participation in National Conferences/ Seminars/ Workshops etc.
- (viii) Blood Donation
- (ix) Participation in activities of College Annual day Celebration
- (x) Organising/ Participation/ Volunteer in different activities organised by the departments/ institute
- (xi) Organising/ Participation in activities of Students Chapters of ISTE, IE (I), IEEE, IETE, Vivekanand Kendra etc.

201 COMMUNICATION TECHNIQUES

Unit 1

Elements of Communication

1. Communication: Meaning, Importance and Process
2. Objectives of Communication
3. Media and Types of Communication

Unit 2

Basics of Communication

1. Verbal and Non-Verbal Communication
2. Formal and Informal Channels of Communication
3. Qualities of Good Communication

Unit 3

Skills of Communication

1. Barriers to Communication
2. Professional Communication

3. Interpersonal Communication and methods to improve it

Unit 4

Grammar

1. Subject-Verb Agreement (Concord)
2. Linking Words (Conjunctions)
3. Relative Clauses
4. Common Errors

Unit 5

Composition

1. Resume Writing
2. Business Letter Writing: Sales, Credit, Enquiry, Order, Claim, Complaint, Job Applications, etc.
3. E-mail messages
4. Telephone Etiquettes

Suggested Readings

1. Communication Skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning Pvt. Ltd.(New Delhi)
2. English Grammar and Composition, Gurudas Mukherjee, Ane Books Pvt. Ltd.(New Delhi)
3. Current English Grammar and Usage with Composition, R.P. Sinha, Oxford University Press (New Delhi)
4. Effective Technical Communication, M Ashraf Rizvi, Tata McGraw Hill (New Delhi)
5. Business Communication, Meenakshi Raman & Prakash Singh, Oxford University Press (New Delhi)
6. Professional Communication, Aruna Koneru, Tata McGraw Hills, New Delhi.
7. A Practical Course for Developing Writing Skills in English, J.K. Gangal, PHI Learning Pvt. Ltd., New Delhi.
8. “Communicative English for Engineers and Professionals”, by Nitin Bhatnagar & Mamta Bhatnagar, Pearson (New Delhi).
9. “The Ace of Soft Skills”, by Gopalswamy Ramesh & Mahadevan Ramesh, Pearson (New Delhi)

202 ENGINEERING MATHEMATICS-II

Unit 1

Coordinate Geometry of Three Dimensions: Equation of a sphere, Intersection of a sphere and a plane, tangent plane, Intersection of two spheres, orthogonality of two spheres, Right circular cone. Right circular cylinder.

Unit 2

Matrices: Rank of a matrix, Rank of matrix by reducing to normal forms, Consistency of systems of linear simultaneous equations and its solution, Eigen values and Eigen vectors, Cayley-

Hamilton theorem (without proof), Diagonalization of matrix.

Unit 3

Vector Calculus: Scalar and vector field, differentiation & integration of vector functions, Gradient, Divergence, Curl and Differential Operator, Line, Surface and volume Integrals.

Unit 4

Application of Vector Calculus: Green's Theorem in a Plane, Gauss's and Stoke's Theorem (without proof) and their Applications.

Fourier Series: Expansion of simple functions in Fourier Series, half range Fourier sine and cosine series, change of interval. Harmonic Analysis.

Unit 5

Differential Equations: Series Solutions of Second Order Linear Differential Equations with Variable Coefficients (Complementary Functions only), Partial Differential Equations of First Order : Lagrange's Form, Standard Forms, Charpit's Method .

Suggested Readings

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley 9th Edition.
2. Calculus and Analytical Geometry, Thomas and Finney, Narosa Publishing House N. Delhi.
3. A Text Book of Differential Equations, M.Ray and Chaturvedi, Students Friends & Co. Publisher, Agra.
4. Higher Engineering Mathematics, B.V.Ramana, Tata Mcgra Hill.
5. Mathematics for Engineers, Chandrika Prasad, Prasad Mudranalaya Allahabad.
6. Advanced Mathematics for Engineers, Chandrika Prasad, Prasad Mudranalaya Allahabad.

203 ENGINEERING PHYSICS-II

Unit 1

Quantum Mechanics: Compton effect & quantum nature of light, Derivation of time dependent and time independent Schrödinger's Wave Equation, Physical interpretation of wave function and its properties, boundary conditions, Particle in one-dimensional box.

Unit 2

Applications of Schrödinger's Equation, Particle in three-dimensional box and Degeneracy, Barrier penetration and tunnel effect, Tunneling probability, Alpha Decay, Summerfield's Free electron gas model Postulates, Density of energy states, Fermi energy level.

Unit 3

Coherence and Optical Fibres, Spatial and temporal coherence, Coherence length, Coherence time and 'Q' factor for light, Visibility as a measure of coherence, Spatial Coherence and size of the source, Temporal coherence and spectral purity, Optical fiber as optical wave-guide, Numerical aperture , maximum angle of acceptance and applications of Optical Fiber.

Unit 4

Lasers and Holography: Theory of laser action, Einstein's coefficients, Components of a laser, Threshold conditions for laser action; Theory, Design and applications of He-Ne and semiconductor lasers; Holography versus photography, Basic theory of holography, Basic requirement of a holographic laboratory; Applications of holography in microscopy and interferometry.

Unit 5

Nuclear Radiation Detectors, Characteristics of gas filled detectors: general considerations, Constructions, Working and properties of: Ionization chamber, proportional counter, G. M. Counter and Scintillation Counter.

Suggested Readings

1. Fundamental of Optics, Jenkins and White, Fourth Edition, McGraw Hill.
2. Optics, Ajoy Ghatak, Third Edition, Tata McGraw Hill.
3. Quantum Mechanics, Schiff, Third Edition, McGraw Hill.
4. Quantum Mechanics, Merzbacher, Third Edition, Wiley India.
5. Nuclear Physics: Principles and Applications, John Lilley, Wiley India.

204 CHEMISTRY & ENVIRONMENTAL ENGINEERING

Unit 1

Water: Common Impurities of water Hardness of water, Determination of hardness by Clark's test and complexometric (EDTA) method, Numerical based on hardness and EDTA method, Municipal Water Supply: Requisites of potable water, Steps involved in purification of water, Sedimentation, coagulation, Filtration and Sterilization, Break point chlorination.

Unit 2

Water Treatment: Softening of water, Lime-Soda, Permutit (Zeolite) and Deionization (Demineralization) methods, Boiler troubles their causes, disadvantages and prevention: Formation of solids (Scale and Sludge), Carry over (Priming and Foaming), Corrosion and Caustic, Embrittlement. Numerical problems based on Lime-Soda and Zeolite softening methods.

Unit 3

Basics of Environment: Environmental Pollution, Environmental Acts and Regulations, Environmental Impact Assessment (EIA), Necessity and methodology of EIA. Renewable sources of energy, Potential & present status of renewable sources of energy in India. Functional concepts of Ecology, Basics of species, Ecosystem, Hydrological and chemical cycles, Energy flow in ecosystems. Biodiversity, population dynamics.

Unit 4

Air Pollution, Noise Pollution and Solid Waste Management: Air Pollution, Harmful effects of Air Pollution, Control of Air Pollution. Noise Pollution, Harmful effects of noise pollution, control of noise pollution. Global warming, Acid rain, Ozone depletion. Solid Waste

Management, Classification of solid waste, Collection, transportation, treatment, and disposal of solid waste. Economic recovery of solid waste. Sanitary landfill, on site sanitation.

Unit 5

Water Pollution: Water pollution, Harmful effects of water pollution, control of water pollution. Waste water management, Treatment & disposal of wastewater. Reuse and saving in use of water, rain water harvesting.

Corrosion: Definition and its significance. Mechanisms of Chemical (Dry) and Electrochemical (Wet) corrosion. Protection from corrosion, Protective coatings, cathodic protection, sacrificial anode and modification in designs.

Suggested Readings

1. Chemistry of water treatment, Samuel Faust & Osman M Aly, CRC Press
2. Boilers water treatment. Principles and Practice, Colin Frayne, CRC Press
3. Corrosion Understanding the Basic, by Joseph R Davis, ASM International
4. Atmospheric pollution, by W Buch , Tata McGraw Hill(TMh)
5. Introduction to Environmental Science, by G Tyler Miller and Scott Spoolman, Cengage Learning
6. Introduction to Environmental Engineering, by Mackenzie L Davis and David A Cornwell, Tata McGraw Hill(TMh)

205 ENGINEERING MECHANICS

Unit 1

Statics Of Particles and Rigid Bodies: Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Varignon's Theorem, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem.

Virtual work: Principle of Virtual Work, Active forces and active force diagram.

Unit 2

Centroid & Moment of Inertia: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar moment of inertia, M.I of solid bodies.

Lifting Machines: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of Pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel, Single purchase winch crab.

Unit 3

Friction: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction.

Belt Drive: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Length of belt, Ratio of tensions and power transmission by flat belt drives.

Unit 4

Kinematics of Particles and Rigid Bodies: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion.

Kinetics of Particles and Rigid Bodies: Newton's laws, Equation of motion in rectangular coordinate, radial and transverse components, Equation of motion in plane for a rigid body, D'Alembert principle.

Unit 5

Work, Energy and Power: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy.

Impulse and Momentum: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body.

Suggested Readings

1. Vector Mechanics for Engineers, Beer and Johnston, Tata McGraw-Hill.
2. Engineering Mechanics, Hibbeler, Pearson Education.
3. Engineering Mechanics, Meriam and Kraige, John Wiley & Sons.
4. Engineering Mechanics, Timoshenko and Young, Tata McGraw-Hill.
5. Engineering Mechanics, Shames, Pearson Education.
6. Engineering Mechanics, Boresi and Schmidt, CL-Engineering.
7. Engineering Mechanics, Andrew Pytel & Kiusalas, Cengage Learning.

206 FUNDAMENTAL OF COMPUTER PROGRAMMING

UNIT – 1

Programming in C: Structure of C Program, Concept of Preprocessor, Macro Substitution, Intermediate code, Object Code, Executable Code. Compilation Process, Basic Data types, Importance of braces ({ }) in C Program, enumerated data type, Identifiers, Scope of Variable, Storage Class, Constants, Operators & Expressions in C, Type Casting, printf () and scanf () with format specifiers, reading single character.

UNIT – 2

Control Statements, Command Line Arguments, Arrays in C, Pointers, Using pointers to represent arrays, Pointer & address arithmetic. Structures, using typedef.

UNIT – 3

Arrays of Structures & pointers, File Handling (fscanf, fprintf, feof, fopen, fclose, fread, fwrite only). Dynamic memory Allocation.

UNIT – 4

Functions in C, Passing Parameters (By value & Reference), using returned data, Passing arrays,

structures, array of structures, pointer to structures etc., passing characters and strings, The void pointer.

UNIT – 5

Stored Program Architecture of Computers, Storage Device- Primary Memory and Secondary Storage, Random, Direct, Sequential access methods. Concept of High-Level, Assembly and Low Level programming languages. Representing Algorithms through flow chart, pseudo code, step by step.

Number System: Data Representation, Concept of radix and representation of numbers in radix r with special cases of $r=2, 8, 10$ and 16 with conversion from radix r_1 to radix r_2 . r 's and $(r-1)$'s complement, Representation of alphabets.

Suggested Readings

1. Ritchie & Kernighan, The C Programming language, 2nd Ed., PHI.
2. Dey & Ghosh, Computer Fundamentals and programming in C, Oxford.
3. Kamthane, Programming in C, 2nd Ed., Pearson.
4. Schildt, The Complete Reference, 4th Ed., TMH.
5. Balaguruswamy, Programming in ANSI C, 5th Ed., TMH.
6. V. Rajaraman, Fundamentals of Computers, 5th Ed. PHI, 2011.
7. Forouzan et.al, Computer Science, 3rd Ed. Cenage Learning.

207 ENGINEERING PHYSICS LAB-II

1. To determine the height of water tank with the help of a Sextant.
2. To determine the dispersive power of material of a Prism for Violet Red and yellow colours of Mercury light with the help of a spectrometer.
3. To measure the Numerical Aperture of an Optical Fibre.
4. To determine the ferromagnetic constants retentivity, permeability and susceptibility by tracing B-H curve using C.R.O.
5. To study the Charge & Discharge of a condenser and hence determine time constant (Both current and voltage graphs are to be plotted).
6. To determine the high resistance by method of leakage, using a Ballistic galvanometer.
7. To verify the expression for the resolving power of a Telescope.
8. To determine the specific resistance of the material of a wire by Carey Fosters bridge.
9. To determine the specific resistance of the material of a wire by Carey Fosters bridge.

208 CHEMISTRY & ENVIRONMENTAL ENGINEERING LAB

1. To determine the hardness of water by HCL method.
2. To determine the hardness of water by EDTA method.
3. Determination of CO_2 in a water sample.
4. Measurement of pH of a given sample by pH-meter.
5. To determine free and residual chlorine in a given water sample.
6. Measurement of dissolved oxygen in water.
7. Measurement of conductivity of a given sample by conductivity meter.

8. Measurement of fluoride in water.
9. Measurement of nitrate in water.
10. Determination of sulphate in water.
11. Evaluation of Reverse Osmosis(RO) Process by TDS measurement.

209 COMPUTER PROGRAMMING LAB

S.No. Concept to be covered in the exercise

1. Simple OS Commands, vi editor, compiling program, compiler options, linking libraries.
2. Simple input output program, integer, real, character and string. (Formatted & Unformatted), Using Command Line Arguments.
3. Conditional statement (if, if-else-if, switch-case)
4. Looping & iterations (for, while, do-while, continue, break)
5. Using Arrays (one, two and three dimensional)
6. Using Structures and Union.
7. Program using Function (with and without recursion), passing parameters by value & reference.
8. Using pointers.
9. File handling.

210 MACHINE DRAWING

Introduction to machine drawing

Dimensioning, locations and placing.

Orthographic projections: First & third angle methods

Sheet 1: Orthographic Projections (3 Problems)

Sheet 2: Sectional Views (3 Problems)

Sheet 3: Riveted joints, lap joints, butt joints, chain riveting, zig-zag riveting

Sheet 4: Screw fasteners, different threads, Nuts & bolts locking devices, set screws, foundation

Sheet 5: Bearing, Plumber block

Instructions on free hand sketches

List of free hand sketches

- Different type of lines
- Conventional representation of materials
- Screw fasteners
- Bearing: Ball, roller, needle, foot step bearing
- Coupling: Protected type, flange, and pin type flexible coupling
- Welded joints
- Belts and pulleys
- Pipes and pipe joints
- Valves

Suggested Readings

1. Machine Drawing, Lakshminarayan, Jain Brothers.

2. Machine Drawing, N.D.Bhatt, Charotar Publishing House Pvt. Ltd.

211 COMMUNICATION TECHNIQUES LAB

1. Phonetic Symbols and Transcriptions
2. Word Formation
3. Affixes
4. Listening and speaking Skills.
5. Words often Mis-spelt and Mis- Pronounced
6. One Word for Many.
7. Synonyms and Antonyms.
8. Seminar Presentation.
9. Group Discussion.
10. Job Interview

Suggested Readings and Packages

1. Advanced Manual for Communication Laboratories and Technical Report Writing, D. Sudha Rani, Pearson, (New Delhi)
2. A Course in Phonetics and Spoken English, J. Sethi & P.V. Dhamija, PHI Learning Pvt. Ltd. (New Delhi)
3. English Language Laboratories: A Comprehensive Manual, Nira Konar, PHI Learning Pvt .Ltd. (New Delhi)
4. Communication Skills for Engineers and Scientists, Sangeeta Sharma and Binod Mishra, PHI Learning Pvt. Ltd.(New Delhi).
5. Oxford English Learning Package.(With CDs: Headway Series)
6. Tata McGraw Hills English Learning Package (With CDs)
7. "Oxford Advanced Learners' Dictionary" published by Oxford University Press (New Delhi)

212 DISCIPLINE & EXTRA CURRICULAR ACTIVITIES (DECA)

Component – A

Discipline:

25 Marks

The marks shall be deducted from this component for those who shall involve themselves in indiscipline/undesirable/Ragging activities or in case of penalty of marks imposed by Standing Disciplinary Committee (SDC) and approved by Head of the Institution concerned subject to a maximum of 25 marks.

Component – B

Extra Curricular Activities:

25 Marks

Marks shall be awarded for the participation of students in various Extra Curricular Activities organised by the respective institutions as per the following, subject to a maximum of 25 marks. In case student does not participate in any of the Extra Curricular Activities, he/ she shall be awarded zero(0) marks in DECA - Component B.

- (i) National Cadet Corps (NCC).
- (ii) National Service Scheme (NSS)

- (iii) Scouts & Guide
- (iv) Sports Activities
- (v) Literary Activities & model
- (vi) Cultural Activities
- (vii) Paper Presentation/ Participation in National Conferences/ Seminars/ Workshops etc.
- (viii) Blood Donation
- (ix) Participation in activities of College Annual day Celebration.
- (x) Organising/ Participation/ Volunteer in different activities organised by the departments/ institute
- (xi) Organising/ Participation in activities of Students Chapters of ISTE, IE (I), IEEE, IETE, Vivekanand Kendra etc.

SEMESTER-III to VIII

Course	Electrical Engineering	Code	EE
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SEMESTER III Subject Code	Title	Hrs. / Week			IA	Exam	Total
		L	T	P			
3EE1A	Electronic Devices & Circuits	3	1	Theory Subjects	20	80	100
3EE2A	Circuit Analysis-I	3	1		20	80	100
3EE3A	Digital Electronics	3	1		20	80	100
3EE4A	Object Oriented Programming	3			20	80	100
3EE5A	Electrical Machines-I	3	1		20	80	100
3EE6A	Advanced Engg. Mathematics-1	3			20	80	100
3EE7A	Electronic Devices Lab	Practical laboratory courses		2	45	30	75
3EE8A	Electrical Circuit Lab		2	30	20	50	
3EE9A	Digital Electronics Lab		2	45	30	75	
3EE10A	C++ Programming Lab		2	45	30	75	
3EE11A	Humanities & Social Sciences		2	45	30	75	
3EEDC	Discipline & Extra Curricular Activity						50
Total		18	4	10			1000

SEMESTER IV Subject Code	Title	Hrs. / Week			IA	Exam	Total
		L	T	P			
4EE1A	Analog Electronics	3	1	Theory Subjects	20	80	100
4EE2A	Circuit Analysis-II	3	1		20	80	100
4EE3A	Electrical Measurements	3	1		20	80	100
4EE4A	Generation of Electrical Power	3			20	80	100
4EE5A	Electrical Machines-II	3	1		20	80	100
4EE6A	Advanced Engineering Mathematics-II	3			20	80	100
4EE7A	Analog Electronics Lab	Practical laboratory courses		2	60	40	100
4EE8A	Electrical Measurement Lab		2	45	30	75	
4EE9A	Power System Design Lab		2	30	20	50	
4EE10A	Electrical Machines Lab		2	45	30	75	
4EE11A	Electrical Machine Design		2	30	20	50	
4EEDC	Discipline & Extra Curricular Activity						50
Total		18	4	10			1000

Course	Electrical Engineering	Code	EE
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SEMESTER V Subject Code	Title	Hrs. / Week			IA	Exam	Total	
		L	T	P				
5EE1A	Power Electronics	3	1	Theory Subjects	20	80	100	
5EE2A	Microprocessors & Computer Architecture	3			20	80	100	
5EE3A	Control Systems	3	1		20	80	100	
5EE4A	Data Base Management System	3			20	80	100	
5EE5A	Transmission & Distribution of Electrical Power	3	1		20	80	100	
5EE6.1A	Optimisation Techniques	3	1		20	80	100	
5EE6.2A	Principle of Communication Systems							
5EE6.3A	Introduction to VLSI							
5EE7A	Power Electronics Lab	Practical laboratory courses			2	45	30	75
5EE8A	Microprocessor Lab				2	45	30	75
5EE9A	System Programming Lab			2	45	30	75	
5EE10A	DBMS Lab			2	45	30	75	
5EE11A	Professional Ethics and Disaster Management			2	30	20	50	
5EEDC	Discipline & Extra Curricular Activity						50	
Total		18	3	10			1000	

SEMESTER VI Subject Code	Title	Hrs. / Week			IA	Exam	Total	
		L	T	P				
6EE1A	Modern Control Theory	3	1	Theory Subjects	20	80	100	
6EE2A	High Voltage Engineering	3			20	80	100	
6EE3A	Switchgear & Protection	3	1		20	80	100	
6EE4A	Advanced Power Electronics	3	1		20	80	100	
6EE5A	Smart Grid Technology	3			20	80	100	
6EE6.1A	Advanced Microprocessors	3	1		20	80	100	
6EE6.2A	Power System Instrumentation							
6EE6.3A	Digital Communication and Information Theory							
6EE7A	Control System Lab	Practical laboratory courses			2	45	30	75
6EE8A	Power System Lab				2	45	30	75
6EE9A	Advanced Power Electronics Lab			2	45	30	75	
6EE10A	Smart Grid Lab			2	45	30	75	
6EE11A	Entrepreneurship Development			2	30	20	50	
6EEDC	Discipline & Extra Curricular Activity						50	
Total		18	3	10			1000	

Course	Electrical Engineering	Code	EE
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SEMESTER VII Subject Code	Title	Hrs. / Week			IA	Exam	Total	
		L	T	P				
7EE1A	Power System Planning	3		Theory Subjects	20	80	100	
7EE2A	Power System Analysis	3	1		20	80	100	
7EE3A	Artificial Intelligence Techniques	3			20	80	100	
7EE4A	Non Conventional Energy Sources	3			20	80	100	
7EE5A	Power System Engineering	3	1		20	80	100	
7EE6.1A	Electromagnetic Field Theory	3	1		20	80	100	
7EE6.2A	Computer Aided Design of Electrical Machines							
7EE6.3A	Economic Operation of Power Systems							
7EE7A	Power System Planning Lab	Practical laboratory courses			2	45	30	75
7EE8A	Power System Modelling & Simulation Lab		2		45	30	75	
7EE9A	Industrial Economics & Management		2	30	20	50		
7EETR	Practical Training & Industrial visit		2		100	100		
7EEPR	Project-1		2	50		50		
7EEDC	Discipline & Extra Curricular Activity						50	
	Total	18	2	10			1000	

SEMESTER VIII Subject Code	Title	Hrs. / Week			IA	Exam	Total
		L	T	P			
8EE1A	EHV AC/DC Transmission	3	1	Theory Subjects	20	80	100
8EE2A	Electric Drives and Their Control	3	1		20	80	100
8EE3A	Protection of Power System	3			20	80	100
8EE4.1A	Utilization of Electrical Power	3			20	80	100
8EE4.2A	FACTS Devices & Their Applications						
8EE4.3A	Power System Transients						
8EE5A	Computer Based Power System Lab	Practical laboratory courses		3	60	40	100
8EE6A	Electrical Drives and Control Lab		3	60	40	100	
8EE7A	High Voltage Engineering Lab		2			50	
8EEPR	Project-2		2	120	80	200	
8EESM	Seminar		2	60	40	100	
8EEDC	Discipline & Extra Curricular Activity						50
	Total	12	2	12			1000

Syllabus B.Tech. (Electrical Engineering), 3rd semester

3EE1A: ELECTRONIC DEVICES & CIRCUITS (Common to EE, EX, EC and ED)

B.Tech. (Electrical) 3rd Semester

Max. Marks: 80

3L+1T

Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Semiconductor Physics: Mobility and conductivity, charge densities in a semiconductor, Fermi Dirac distribution, Fermi-Dirac statistics and Boltzmann approximation to the Fermi-Dirac statistics, carrier concentrations and Fermi levels in semiconductor.	5
	Generation and recombination of charges, diffusion and continuity equation, transport equations, Mass action Law, Hall effect.	3
2	Junction Diodes: Formation of homogenous and heterojunction diodes and their energy band diagrams, calculation of contact potential and depletion width, V-I characteristics, Small signal models of diode, Diode as a circuit element, diode parameters and load line concept, C-V characteristics and dopant profile.	4
	Applications of diodes in rectifier, clipping, clamping circuits and voltage multipliers. Transient behavior of PN diode. Breakdown diodes, Schottky diodes, and Zener diode as voltage regulator. Construction, characteristics and operating principle of UJT.	4
3	Transistors: Characteristics, Current Components, Current Gains: alpha and beta. Variation of transistor parameter with temperature and current level, Operating point, Hybrid model, DC model of transistor, h-parameter equivalent circuits. CE, CB and CC configuration	4
	DC and AC analysis of single stage CE, CC (Emitter follower) and CB amplifiers AC & DC load line, Ebers-Moll model. Biasing & stabilization techniques. Thermal runaway, Thermal stability.	4
4	JFET & MOSFET: Construction and operation of JFET & MOSFET, noise performances of FET, parasitic of MOSFET, small signal models of JFET & MOSFET	4
	Biasing of JFET's & MOSFET's. Low frequency single stage CS and CD (source follower) JFET amplifiers. FET as voltage variable resistor and active load.	4
5	Small Signal Amplifiers at Low Frequency: Analysis of BJT and FET multistage amplifier, DC and RC coupled amplifiers. Frequency response of single and multistage amplifier, mid-band gain, gains at low and high frequency.	4
	Analysis of DC and differential amplifiers, Miller's Theorem, use of Miller and bootstrap configuration. Cascade and cascode configuration of multistage amplifiers (CE-CE, CE-CB, CS-CS and CS-CD), Darlington pair.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Millman Halkias, Integrated Electronics, TMH	2011
2	R. L. Boylestad, Louis Nashelsky, Electronic devices & circuits theory, Pearson Education	2009

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	David Bell, Electronic Devices & Circuits, Oxford Publications	2009
2	Schultz, Grob's, Basic Electronics, TMH	2007
3	Millman, Electronics Devices and Circuits, ed. 3, TMH	2006
4	Cathey, Electronics Devices and Circuits, ed. 3, TMH	2005
5	J. Millman and A. Grabel, Microelectronics, TMH, International	1999
6	B. G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi	2002
7	A. S. Sedra and K. C. Smith, Microelectronic Circuits, Saunderson's College, Publishing	2014
8	Salivahnan, Electronics Devices and Circuits, ed. 3, TMH.	2011

3EE2A: CIRCUIT ANALYSIS-I

B.Tech. (Electrical) 3rd Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Introduction to circuit elements and their characteristics. Current and voltage reference. Response of single element, double element and triple element circuits. Resonance, selectivity & Q-factor in ac circuits.	4
	Network Analysis: Network voltages. Mesh & node systems of network equations and their comparison. Graph of network, tree, incidence matrix, fundamental circuit functions, cut sets, f-circuits analysis and f-cut set analysis, node and node pair analysis. Duality. Method of obtaining dual network.	4
2	Network Theorems: Thevenin's, Norton's, Superposition, Reciprocity, Compensation, Millman's theorem	4
	Tellegen's, Maximum power transfer and Miller's theorems in DC & AC Circuits.	4
3	Polyphase Circuits: General Circuit Relations: Three Phase Star, Three Phase Delta, Star and Delta Combination, Four Wire Star Connection. Balanced and unbalanced Three Phase Voltages, currents and Impedances. Power and Reactive Volt-Amperes in a 3-Phase System	5
	Power Relations in AC Circuits: Instantaneous Power in AC Circuits, Power Factor, Apparent Power, Reactive Power, Power Triangle, Complex Power.	3
4	Non-Sinusoidal Waves: Complex Periodic Waves and Their Analysis By Fourier Series. Different Kinds of Symmetry, Determination of Co-Efficient. Average and Effective Values of a Non-Sinusoidal Wave, Power in a Circuit of Non-Sinusoidal Waves of Current and Voltage	6
	Form Factor, Equivalent Sinusoidal Wave and Equivalent Power Factor. Response of Linear Network to Non-Sinusoidal Periodic Waves.	2
5	Time Domain and Frequency Domain Analysis: Response of networks to step, ramp, impulse, pulse and sinusoidal inputs. Time domain and frequency domain analysis of circuits.	4
	Shifting theorem, initial and final value theorems. Special signal waveforms with Laplace transform & applications to circuit operations.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Van Valkenburg, Network Analysis, PHI	2013
2	Hayt & Kemmerly, Engineering Circuit Analysis, 6/e (TMH)	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	J. Edminster & M. Nahvi, Electric Circuits (SIE), 5/e, Scaum's Out Line.	2013
2	Nagsarkar & Sukhija, Circuits & Networks, Oxford	2010
3	John Bird, Electric Circuit Theory & Technology, ELSEVIER	2007
4	D. Roy Chodhary, Network & Systems, New Age	2010
5	Ghosh & Chakrabarti, Network Analysis and Synthesis, (TMH)	2009
6	A. Chakarvorty, Circuit Theory, Publisher DhanpatRai & Co. (Pvt.) Ltd.	2013

3EE3A: DIGITAL ELECTRONICS (Common to EE, EX, EC, EIC, CS and IT)**B.Tech. (Electrical) 3rd Semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Number Systems, Basic Logic Gates & Boolean Algebra: Binary Arithmetic & Radix representation of different numbers. Sign & magnitude representation, Fixed point representation, complement notation, various codes & arithmetic in different codes & their inter conversion.	4
	Features of logic algebra, postulates of Boolean algebra. Theorems of Boolean algebra. Boolean function. Derived logic gates: Exclusive-OR, NAND, NOR gates, their block diagrams and truth tables. Logic diagrams from Boolean expressions and vice-versa. Converting logic diagrams to universal logic. Positive, negative and mixed logic. Logic gate conversion.	4
2	Digital Logic Gate Characteristics: TTL logic gate characteristics: Theory & operation of TTL NAND gate circuitry. Open collector TTL. Three state output logic.	4
	TTL subfamilies. MOS & CMOS logic families. Realization of logic gates in RTL, DTL, ECL, C-MOS & MOSFET. Interfacing logic families to one another.	4
3	Minimization Techniques: Minterm, Maxterm, Karnaugh Map, K map upto 4 variables. Simplification of logic functions with K-map	4
	Conversion of truth tables in POS and SOP form. Incomplete specified functions. Variable mapping. Quinn-McKlusky minimization techniques.	4
4	Combinational Systems: Combinational logic circuit design, half and full adder, subtractor. Binary serial and parallel adders. BCD adder. Binary multiplier. Decoder: Binary to Gray decoder, BCD to decimal, BCD to 7-segment decoder.	4
	Multiplexer, demultiplexer, encoder. Octal to binary, BCD to excess-3 encoder. Diode switching matrix. Design of logic circuits by multiplexers, encoders, decoders and demultiplexers.	4
5	Sequential Systems: Latches, flip-flops, R-S, D, J-K, Master Slave flip flops. Conversions of flip-flops.	3
	Counters: Synchronous & asynchronous ripple and decade counters, Modulus counter, skipping state counter, counter design, state diagrams and state reduction techniques. Ring counter. Counter applications. Registers: buffer register, shift register.	5

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Herbert Taub, Donald L. Schilling, Digital Integrated Electronics, TMH	2008
2	M. Morris Mano, Digital Logic and Computer Design, Pearson Edu.	2014

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Millman Taub, Pulse Switching and Network, TMH	2009
2	A. Anandkumar, Fundamentals of Digital circuits, PHI	2009
3	Floyd, Digital Fundamentals, Pearson	2008
4	S. Salivahanan, Sarivazhagan, Digital circuit design, Vikas publications	2009
5	Leach, Digital Principles and Applications, ed. 7, TMH	2008
6	Mandal, Digital Electronics: Principles and Applications, TMH	2009

3EE4A: OBJECT ORIENTED PROGRAMMING (Common to EE, EX, CS and IT)**B.Tech. (Electrical) 3rd Semester
3L****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Review of structures in C, accessing members of structures using structure variables, pointer to structures, passing structures to functions	5
	Structures as user defined data types.	3
2	Introduction to Programming Paradigms: (Process oriented and Object oriented). Concept of object, class, objects as variables of class data type, difference in structures and class in terms of access to members, private and public Basics of C++: Structure of C++ programs, introduction to defining member functions within and outside a class, keyword <i>using</i> , declaring class, creating objects, constructors & destructor functions, Initializing member values with and without use of constructors, simple programs to access & manipulate data members, <i>cin</i> and <i>cout</i> functions.	4
	Dangers of returning reference to a private data member, constant objects and members function, composition of classes, friend functions and classes, using <i>this</i> pointer, creating and destroying objects dynamically using <i>new</i> and <i>delete</i> operators. Static class members, container classes and iterators, proxy classes. Members of a class, data & function members. Characteristics of OOP- Data hiding, Encapsulation, data security.	4
3	Operator Overloading: Fundamentals, Restrictions, operator functions as class members v/s as friend functions.	4
	Overloading stream function, binary operators and unary operators. Converting between types.	4
4	Inheritance: Base classes and derived classes, protected members, relationship between base class and derived classes, constructors and destructors in derived classes, public, private and protected inheritance	4
	Relationship among objects in an inheritance hierarchy, abstract classes, virtual functions and dynamic binding, virtual destructors.	4
5	Multiple inheritance, virtual base classes, pointers to classes and class members, multiple class members. Templates, exception handling.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Dietel, How to Program C++, Pearson	2013
2	K. R. Venugopal, Mastering C++, TMH	1999

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Robert Lafore, Object Oriented Programming in C++, Pearson	2001
2	Rambaugh, Object Oriented Design & Modelling, Pearson	2004

3EE5A: ELECTRICAL MACHINES-I (Common to EE and EX)

**B.Tech. (Electrical) 3rd Semester
3L+1T**

**Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	(I)Magnetic circuits: Magnetic circuits, magneto motive force magnetic field strength, permeability, reluctance, analogy between electric and magnetic-circuits, B-H curve, hysteresis, series and parallel magnetic circuits, practical magnetic circuits, permanent magnet and their applications.	5
	(ii)Electromechanical energy conversion: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field.	3
2	DC Generators: Introduction, construction, types, emf equation, lap and wave windings, armature reaction, commutation, methods of improving commutation, equalizer rings	4
	Demagnetizing and cross magnetizing ampere turns, various characteristics of shunt, series and compound generators, voltage build up, losses and efficiency, condition for maximum efficiency.	4
3	DC Motors: Introduction, principals, back-emf, torque of motor, types, characteristics of shunt, series and compound motors, speed control (field and armature control methods), basic idea of solid state devices in controlling of DC motors	4
	Starting of DC motors, three point and four point starters, losses and efficiency, testing (brake test and swimburnes test), electric braking of DC motors, Applications.	4
4	Transformer: Construction, Principal, Types, emf equation, no load and short circuit test, equivalent circuits, back-to-back (Sumpner's test), phasor diagram, Voltage regulation	6
	Efficiency, Condition for maximum efficiency, all day efficiency, parallel operation , auto-transformer, basic idea of welding transformer, current and potential transformer,separation of losses.	2
5	Polyphase Transformer: Construction,Various connections and groups, choice of connections, open delta connection, Scott connection, three phase to two phase conversion and vice-versa, Applications, Parallel operation and its conditions	4
	Three to six phase conversion.Excitation phenomenon in transformers, magnetizing harmonic currents and their effects,switching currents in transformers, inrush of magnetizing current.Three winding transformer.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	A. E. Fitzgerald, C. Kingsley Jr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition.	2002
2	Kothari & Nagrath, Electric Machines, 3/e, TMH	2004

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. G. Say, The Performance and Design of AC machines, Pit man & Sons.	2003
2	Guru, Electric Machinery, 3e, Oxford	2000
3	R. K. Srivastava, Electrical Machines, Cengage Learning.	2013
4	P. S. Bimbhra, Electrical Machinery, Khanna Pub.	1995
5	Stephen J Chapman, Electric Machinery Fundamentals, McGraw-Hill	2001
6	Husain Ashfaq, Electrical Machines, DhanpatRai& Sons	2013

3EE6A: ADVANCED ENGINEERING MATHEMATICS-I (Common to EE and EX)**B.Tech. (Electrical) 3rd Semester
3L****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Laplace Transform: Laplace transform with its simple properties, applications to the solution of ordinary and partial differential equations having constant coefficients with special reference to wave and diffusion equations, digital transforms.	8
2	Fourier Transform: Discrete Fourier transform, Fast Fourier transform, Complex form of Fourier transform and its inverse applications	4
	Fourier transform for the solution of partial differential equations having constant coefficients with special reference to heat equation and wave equation.	4
3	Fourier Series: Expansion of simple functions in Fourier series, half range series, change of interval, harmonic analysis.	5
	Calculus of Variation: Functional, strong and weak variations, simple variation problems, Euler's equation	
4	Complex Variables: Analytic functions, Cauchy-Riemann equations, Elementary conformal mapping with simple applications	6
	Line integral in complex domain, Cauchy's theorem, Cauchy's integral formula.	2
5	Complex Variables: Taylor's series, Laurent's series, poles, Residues. Evaluations of simple definite real integrals using the theorem of residues. Simple contour integration.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. Ray, J. C. Chaturvedi & H.C. Sharma, Differential Equations, Students friends & company	2011
2	Chandrika Prasad, Mathematics for Engineers, Prasad Mudralaya	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Bird, Higher Engineering Mathematics, ELSEVIER.	2004
2	Jeffrey, Advanced Engineering Mathematics, ELSEVIER.	2001
3	Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya	2006
4	Ervin Kreyzig, Advanced Engineering Maths, Wiley.	2005

3EE7A: ELECTRONIC DEVICES LAB (Common to EE, EX, EC and EI)

1. Study the following devices: (a) Analog & digital multimeters (b) Function/ Signal generators (c) Regulated d. c. power supplies (constant voltage and constant current operations) (d) Study of analog CRO, measurement of time period, amplitude, frequency & phase angle using Lissajous figures.
2. Plot V-I characteristic of P-N junction diode & calculate cut-in voltage, reverse saturation current and static & dynamic resistances.
3. Plot V-I characteristic of zener diode and study of zener diode as voltage regulator. Observe the effect of load changes and determine load limits of the voltage regulator.
4. Plot frequency response curve for single stage amplifier and to determine gain bandwidth product.
5. Plot drain current - drain voltage and drain current – gate bias characteristics of field effect transistor and measure of I_{DSS} & V_p .
6. Application of Diode as clipper & clamper.
7. Plot gain- frequency characteristic of two stage RC coupled amplifier & calculate its bandwidth and compare it with theoretical value.
8. Plot gain- frequency characteristic of emitter follower & find out its input and output resistances.
9. Plot input and output characteristics of BJT in CB, CC and CE configurations. Find their h-parameters.
10. Study half wave rectifier and effect of filters on wave. Also calculate theoretical & practical ripple factor.
11. Study bridge rectifier and measure the effect of filter network on DC voltage output and ripple factor.

3EE8A: ELECTRICAL CIRCUIT LAB

1. Draw the circuit symbols.
2. Verify theorems for A. C. & D. C. circuits.
3. PSPICE Programs for Circuit Analysis:
 - a. DC: Analysis resistor networks to determine node voltages, components voltages, and component currents.
 - b. DC: Analysis of resistor networks that have several voltage and current sources and variable load resistors.
 - c. Transient: Analysis of RC & RL circuits to produce tables of component voltage & current levels for a given set of time instants & to produce graphs of voltages & currents versus time.
 - d. AC: Analysis of impedance networks to determine the magnitude & phase of node voltages, components voltages and component currents.
4. Determine the magnitude & phase and component voltages and currents in resonant circuits & produce voltage and current versus frequency graphs.
5. Programs for Circuit Analysis:
 - a. Calculate the resistance of a conductor, given its dimensions & resistivity or determine the change in conductor resistance when the temp changes.
 - b. D.C.: Analysis of resistor networks to determine all junction voltages, component voltages, and component currents.
 - c. Transient: Analysis RC & RL circuits to produce tables of component voltage & current levels for a given set of time instants.
6. Convert Y-connected resistor networks to delta-connected circuits.

3EE9A: DIGITAL ELECTRONICS LAB (Common to EE, EX, EC, EI, CS and IT)

1. To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3, & 4 inputs using gates with 2, 3, & 4 inputs).
2. To verify the truth table of OR, AND, NOR, Ex-OR, Ex-NOR realized using NAND & NOR gates.
3. To realize an SOP and POS expression
4. To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables.
5. To realize a 4-bit ripple adder/ Subtractor using basic Half adder/ Subtractor & basic Full Adder/ Subtractor.

6. To verify the truth table of 4-to-1 multiplexer and 1-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and 1-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demultiplexer.
7. Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -312 seven-segment display.
8. Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table
9. Construct a divide by 2,4& 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.
10. Perform input/output operations on parallel in/Parallel out and Serial in/Serail out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

Note: As far as possible, the experiments shall be performed on bread board. However, Experiment Nos. 1-4 are to be performed on bread board only.

3EE10A: C++ PROGRAMMING LAB (Common to EE, EX, CS and IT)

1. To write a simple program for understanding of C++ program structure without any CLASS declaration. Program may be based on simple input output, understanding of keyword using.
2. Write a C++ program to demonstrate concept of declaration of class with public & private member, constructors, object creation using constructors, access restrictions, defining member functions within and outside a class. Scope resolution operators, accessing an object's data members and functions through different type of object handle name of object, reference to object, pointer to object, assigning class objects to each other.
3. Program involving multiple classes (without inheritance) to accomplish a task. Demonstrate composition of class.
4. Demonstration Friend function friend classes and this pointer.
5. Demonstration dynamic memory management using new & delete & static class members.
6. Demonstration of restrictions an operator overloading, operator functions as member function and/ or friend function, overloading stream insertion and stream extraction, operators, overloading operators etc.
7. Demonstrator use of protected members, public & private protected classes, multi-level inheritance etc.
8. Demonstrating multiple inheritance, virtual functions, virtual base classes, abstract classes

3EE11A: HUMANITIES & SOCIAL SCIENCE (Common to EE and EX)

Unit 1

India: Brief history of Indian Constitution, farming features, fundamental rights, duties, directive principles of state. History of Indian National Movement, socio economic growth after independence.

Unit 2

Society: Social groups- concept and types, socialization- concept and theory, social control: concept, social problem in contemporary India, status and role.

Unit 3

The Fundamentals of Economics: meaning, definition and importance of economics, Logic of choice, central economic problems, positive and normative approaches, economic systems-socialism and capitalism.

Unit 4

Microeconomics: Law of demand supply, utility approach, indifference curves, elasticity of demand and supply and applications, consumer surplus, Law of returns to factors and returns to scale.

Unit 5

Macroeconomics: concepts relating to National product-National income and its measurement, Simple Keynesian theory, simple multiplier, money and banking. Meaning, concept of international trade, determination of exchange rate, Balance of payments.

Syllabus B.Tech. (Electrical Engineering), 4th semester

4EE1A:ANALOG ELECTRONICS (Common to EE, EX, EC and EI)

B.Tech. (Electrical) 4th semester
3L+1T

Max. Marks: 80

Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Feedback Amplifiers: Classification, Feedback concept, Feedback Topologies, Transfer gain with feedback, General characteristics of negative feedback amplifiers	5
	Analysis of voltage-series, voltage-shunt, current-series and current-shunt feedback amplifier. Stability criterion. Compensation techniques, miller compensation.	3
2	Oscillators & Multivibrators: Classification. Criterion for oscillation. Tuned collector, Hartley, Colpitts, RC Phase shift, Wien Bridge and crystal oscillators	5
	Astable, monostable and bistable multivibrators. Schmitt trigger. Blocking oscillators	3
3	High Frequency Amplifiers: Hybrid Pi model, conductances and capacitances of hybrid Pi model, high frequency analysis of CE amplifier	4
	Gain bandwidth product, unity gain frequency f_T . Emitter follower at high frequencies.	4
4	Tuned Amplifier: Band pass amplifier, Parallel resonant circuits, Band Width of Parallel resonant circuit. Analysis of Single Tuned Amplifier, Primary & Secondary Tuned Amplifier with BJT & FET	4
	Double Tuned Transformer Coupled Amplifier. Stagger Tuned Amplifier. Pulse Response of such Amplifier. Class C tuned amplifiers, Shunt Peaked Circuits for Increased Bandwidth.	4
5	Power Amplifiers: Classification, Power transistors & power MOSFET (DMOS, VMOS). Output power, power dissipation and efficiency analysis of Class A, class B, class AB, class C, class D and class E amplifiers as output stages.	4
	Pushpull amplifiers with and without transformers. Complementary symmetry & quasi complementary symmetry amplifiers	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Millman, Integrated Electronics, ed. 2, TMH.	2010
2	A. S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford university press.	2009

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. H. Rashid, Microelectronic Circuits Analysis and design, Cengage Learning.	2009
2	David A. BELL, Electronic Devices and Circuits, Oxford university press.	2009
3	Salivahnan, Electronics Devices and Circuits, ed. 3, TMH.	2011

4EE2A: CIRCUIT ANALYSIS-II

B.Tech. (Electrical) 4th semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Impedance and Admittance Functions: The concept of complex frequency, transform impedance and admittance, series and parallel combinations	8
2	Network Functions: Terminals and terminal pairs, driving point impedance transfer functions, poles and zeros. Restrictions on pole and zero location in s-plane. Time domain behavior from pole and zero plot. Procedure for finding network functions for general two terminal pair networks	5 3
3	Network Synthesis: Hurwitz polynomial, positive real functions, reactive networks. Separation property for reactive networks. The four-reactance function forms, specification for reactance function. Foster form of reactance networks. Cauer form of reactance networks. Synthesis of R-L and R-C networks in Foster and Cauer forms.	3 5
4	Two Port General Networks: Two port parameters (impedance, admittance, hybrid, ABCD parameters) and their inter relations. Equivalence of two ports. Transformer equivalent, inter connection of two port networks. The ladder network, image impedance, image transfer function, application to L-C network, attenuation and phase shift in symmetrical T and pi networks.	2 6
5	Two Port Reactive Network (Filters): Constant K filters. The m-derived filter. Image impedance of m-derived half (or L) sections, composite filters. Bands pass and band elimination filters. The problem of termination, lattice filters, Barlett's bisection theorem. Introduction to active filters.	5 3

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern	2014
2	Nagsarkar & Sukhija, Circuits & Networks, Oxford	2011

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern	2008
2	Nagsarkar & Sukhija, Circuits & Networks, Oxford	2011
3	M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern	2008
4	Nagsarkar & Sukhija, Circuits & Networks, Oxford	2011
5	M. E. Van Valkenburg, An Introduction to Modern Network Synthesis, Wiley Eastern	2008

4EE3A: ELECTRICAL MEASUREMENTS (Common to EE and EX)

B.Tech. (Electrical) 4th semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Measuring Instruments: Moving coil, moving iron, electrodynamic and induction instruments-construction, operation, torque equation and errors. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy.	6
	Errors in wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading.	2
2	Polyphase Metering: Blondel's Theorem for n-phase, p-wire system. Measurement of power and reactive kVA in 3-phase balanced and unbalanced systems: One-wattmeter, two-wattmeter and three-wattmeter methods. 3-phase induction type energy meter. Instrument Transformers: Construction and operation of current and potential transformers.	5
	Ratio and phase angle errors and their minimization. Effect of variation of power factor, secondary burden and frequency on errors. Testing of CTs and PTs. Applications of CTs and PTs for the measurement of current, voltage, power and energy.	3
3	Potentiometers: Construction, operation and standardization of DC potentiometers– slide wire and Crompton potentiometers. Use of potentiometer for measurement of resistance and voltmeter and ammeter calibrations.	4
	Volt ratio boxes. Construction, operation and standardization of AC potentiometer – in-phase and quadrature potentiometers. Applications of AC potentiometers.	4
4	Measurement of Resistances: Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method.	4
	Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guard-wire method. Measurement of earth resistance.	4
5	AC Bridges: Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for self-inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement.	4
	Wien's bridge for capacitance and frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. Wagner earth device.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	H. S. Kalsi, Electronic Inst. & Measurement, TMH	2004
2	Morris, Electrical Measurements & Instrumentation, ELSEVIER	1997

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Bell, Electronic Instrumentation And Measurement, Oxford	1994
2	W. D. Cooper, Electronic Inst. & Measurement Techniques, Prentice Hall, India.	2004
3	A. K. Sawhney, Electrical & Electronic Measurement & Inst, DhanpatRai& Sons	2002
4	E. W. Golding & F. C. Widdis, Electrical Measurement & Measuring Instrument, A.W. Wheeler	2004
5	Forest K. Harries, Electrical Measurement, Willey Eastern Pvt. Ltd. India.	2008

4EE4A: GENERATION OF ELECTRICAL POWER

B.Tech. (Electrical) 6th semester

Max. Marks: 80

3L

Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Conventional Energy Generation Methods : (i) Thermal Power plants: Basic schemes and working principle. (ii) Gas Power Plants: open cycle and closed cycle gas turbine plants, combined gas & steam plants-basic schemes.	5
	(iii) Hydro Power Plants: Classification of hydroelectric plants. Basic schemes of hydroelectric and pumped storage plants. (iv) Nuclear Power Plants: Nuclear fission and nuclear fusion. Fissile and fertile materials. Basic plant schemes with boiling water reactor, heavy water reactor and fast breeder reactor. Efficiencies of various power plants	3
2	New Energy Sources: Impact of thermal, gas, hydro and nuclear power stations on environment. Green House Effect (Global Warming).Renewable and non-renewable energy sources	5
	Conservation of natural resources and sustainable energy systems. Indian energy scene. Introduction to electric energy generation by wind, solar and tidal.	3
3	Loads and Load Curves: Types of load, chronological load curve, load duration curve, energy load curve and mass curve. Maximum demand, demand factor, load factor, diversity factor, capacity factor and utilization.	4
	Power Factor Improvement: Causes and effects of low power factor and advantages of power factor improvement. Power factor improvement using shunt capacitors and synchronous condensers.	4
4	Power Plant Economics: (i) Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost. Role of load diversity in power system economics.	5
	(ii) Calculation of most economic power factor when (a) kW demand is constant and (b) kVA demand is constant. (iii) Energy cost reduction: off peak energy utilization, co-generation, and energy conservation.	3
5	(i) Tariffs: Objectives of tariffs. General tariff form. Flat demand rate, straight meter rate, block meter rate. Two part tariff, power factor dependent tariffs, three-part tariff. Spot (time differentiated) pricing.	4
	(ii) Selection of Power Plants: Comparative study of thermal, hydro, nuclear and gas power plants. Base load and peak load plants. Size and types of generating units, types of reserve and size of plant. Selection and location of power plants.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	B. R. Gupta. Generation of Electrical Energy (4/e), S. Chand Publication.	2013
2	S. L. Uppal. Electrical Power (13/e), Khanna Publishers	2009

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	V. K. Mehta, Principles of Power system (3/e), S. Chand Publication	2005
2	Soni, Gupta and Bhatnagar, Generation of Electrical Power, Dhanpat Rai & Sons	1996
3	L. Elgerd Olle, Electric Energy Systems Theory, PHI	2013
4	C. A. Gross, Power System Analysis, TMH	1979

4EE5A: ELECTRICAL MACHINES –II (Common to EE and EX)

B.Tech. (Electrical) 6th semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	AC Machines Fundamentals: Introduction, emf equation, mmf of three phase AC winding, production of rotating magnetic field, types of AC windings	5
	Concentric, distributed and chording windings, pitch factor, distribution factor, effect of these factors on induced emf, effect of harmonics.	3
2	Polyphase Induction Motor: Introduction. Construction, cage and wound rotors, principal, starting and running torque, condition for maximum torque, equivalent circuits, no load and block rotor test.	5
	Torque-slip characteristics, losses and efficiency, circle diagram, starting of cage and wound motors, speed control, cogging and crawling, double cage rotor, induction generator, application.	3
3	(i) Single Phase Induction Motor: Introduction, construction, principal, double revolving field theory, equivalent circuit, performance calculations, starting methods, and their types, torque slip characteristics of various types.	4
	ii) Special Machines: Single phase synchronous motor, series motor, universal motor, Stepper motors variable reluctance, permanent magnet and hybrid stepper motors.	4
4	Synchronous Generators (Alternators): Introduction, Construction, advantages of rotating field, types of rotors, emf equation, excitation systems, equivalent circuit and their phasor diagrams, voltage regulation, synchronous impedance method, mmf method.	5
	Zero power factor method, two reaction theory of salient pole rotor, phasor diagram, power developed and power angle characteristics of salient pole machine, determination of X_d and X_q , synchronization, synchronizing power and torque, parallel operation application.	3
5	Synchronous Motors: Introduction, construction, principal of operation, starting of synchronous motor, equivalent circuit and phasor diagrams, power and torque, performance calculation, speed torque characteristics, power factor control-effect of change of excitation.	4
	V curve and inverted V curve, synchronous condenser and reactors, synchronous phase modifiers, hunting-causes and remedies, applications, synchronous induction motor application.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	A. E. Fitzgerald, C. Kingsley Jr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition.	2002
2	Kothari & Nagrath, Electric Machines 3/e, TMH	2004

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. G. Say, The Performance and Design of AC machines, Pit man & Sons.	2002
2	Guru, Electric Machinery 3e, Oxford	2000
3	R. K. Srivastava, Electrical Machines, Cengage Learning.	2010
4	P. S. Bimbhra, Electrical Machinery, Khanna Pub.	1995
5	Stephen J Chapman, Electric Machinery Fundamentals, McGraw-Hill	2001
6	Husain Ashfaq, Electrical Machines, Dhanpat Rai & Sons	2012
7	Irving L. Kosow, Electric Machine and Transformers, Prentice Hall of India.	1992

4EE6A: ADVANCED ENGINEERING MATHEMATICS-II (Common to EE and EX)**B.Tech. (Electrical) 4th semester
3L****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Numerical Analysis: Finite differences - Forward backward and central difference. Newton's forward and backward differences interpolation formulae. Sterling's formulae, Lagrange's interpolation formula. Solution of non-linear equations in one variable by Newton Raphson and Simultaneous algebraic equation by Gauss and Regula Falsi method.	6
	Solution of simultaneous equations by Gauss elimination and Gauss Seidel methods. Fitting of curves (straight line and parabola of second degree) by method of least squares.	2
2	Numerical Analysis: Numerical differentiation, numerical integration trapezoidal rule, Simpson's one-third and one eighth rule. Numerical Integration of ordinary differential equations of first order	5
	Picard's method, Euler's & modified Euler's methods. Milne's method and Runge Kutta fourth order method. Simple linear difference equations with constant coefficients.	3
3	Special Functions: Bessel's function of first and second kind, simple recurrence relations, orthogonal property of Bessel functions, Transformation, Generating functions	4
	Legendre's function of first kind, simple recurrence relations, orthogonal property, Generating functions.	4
4	Statistics & Probability: Elementary theory of probability, Baye's theorem with simple applications, Expected value.	4
	Theoretical probability distributions – Binomial, Poisson and Normal distributions.	4
5	Statistics & Probability: Lines of regression, co-relation and rank correlation.	4
	Transforms: Z-transforms, its inverse, simple properties and application to difference equations.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Jeffrey, Advanced Engineering Mathematics, ELSEVIER	2006
2	Ervin Kreyzig, Advanced Engineering Maths, John Wiley	2010

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Bird, Higher Engineering Mathematics , ELSEVIER	2004
2	Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya	2002
3	Kaplan, W., Advanced Mathematics for Engineers, Addison-Wesley Publishing Co.	2008
4	Brigham, E.O., The Fast Fourier Transform and its Applications, Prentice-Hall	1988
5	J. N. Kapur, Mathematical Statistics, S. Chand & company Ltd	2000
6	R. K. Jain & S. R. K. Iyenger, Advance Engineering Mathematics, Narosa Pub.	2002
7	E. Kreyzig, Advanced Engineering Mathematics, John Wiley & Sons	2005

4EE7A: ANALOG ELECTRONICS LAB (Common to EE, EX, EC and EI)

1. Plot gain-frequency characteristics of BJT amplifier with and without negative feedback in the emitter circuit and determine bandwidths, gain bandwidth products and gains at 1kHz with and without negative feedback.
2. Study of series and shunt voltage regulators and measurement of line and load regulation and ripple factor.
3. Plot and study the characteristics of small signal amplifier using FET.
4. Study of push pull amplifier. Measure variation of output power & distortion with load.
5. Study Wein bridge oscillator and observe the effect of variation in R & C on oscillator frequency.
6. Study transistor phase shift oscillator and observe the effect of variation in R & C on oscillator frequency and compare with theoretical value.
7. Study the following oscillators and observe the effect of variation of C on oscillator frequency: (a) Hartley (b) Colpitts.
8. Design Fabrication and Testing of k-derived filters (LP/HP).
9. Study of a Digital Storage CRO and store a transient on it.
10. To plot the characteristics of UJT and UJT as relaxation.
11. To plot the characteristics of MOSFET and CMOS.

4EE8A: ELECTRICAL MEASUREMENT LAB (Common to EE and EX)

1. Study working and applications of (i) C.R.O. (ii) Digital Storage C.R.O. & (ii) C.R.O. Probes.
2. Study working and applications of Meggar, Tong-tester, P.F. Meter and Phase Shifter.
3. Measure power and power factor in 3-phase load by (i) Two-wattmeter method and (ii) One-wattmeter method.
4. Calibrate an ammeter using DC slide wire potentiometer.
5. Calibrate a voltmeter using Crompton potentiometer.
6. Measure low resistance by Crompton potentiometer.
7. Measure Low resistance by Kelvin's double bridge.
8. Measure earth resistance using fall of potential method.
9. Calibrate a single-phase energy meter by phantom loading at different power factors.
10. Measure self-inductance using Anderson's bridge.
11. Measure capacitance using De Sauty Bridge

4EE9A: POWER SYSTEM DESIGN LAB

1. Generating station design: Design considerations and basic schemes of hydro, thermal, nuclear and gas power plants. Electrical equipment for power stations.
2. Auxiliary power supply scheme for thermal power plant.
3. Distribution system Design: Design of feeders & distributors. Calculation of voltage drops in distributors. Calculation of conductor size using Kelvin's law.
4. Methods of short term, medium term and long term load forecasting.
5. Sending end and receiving end power circle diagrams.
6. Instrument Transformers: Design considerations of CTs & PTs for measurement and protection.
7. Substations: Types of substations, various bus-bar arrangements. Electrical equipment for substations.

4EE10A:ELECTRICAL MACHINE LAB (Common to EE and EX)

1. Speed control of D.C. shunt motor by (a) Field current control method & plot the curve for speed versus field current. (b) Armature voltage control method & plot the curve for speed versus armature voltage.
2. To perform O.C. and S.C. test on a 1-phase transformer and to determine the parameters of its equivalent circuit its voltage regulation and efficiency.
3. To perform back-to-back test on two identical 1-phase transformers and find their efficiency & parameters of the equivalent circuit.
4. To determine the efficiency and voltage regulation of a single-phase transformer by direct loading.
5. To plot the O.C.C. & S.C.C. of an alternator and to determine its Z_s , X_d and regulation by synchronous impedance method.
6. To plot the V-curve for a synchronous motor for different values of loads.
7. To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit.
8. To perform no load and blocked rotor test on a 3 phase induction motor and to determine the parameters of its equivalent circuits. Draw the circle diagram and compute the following (i) Max. Torque (ii) Current (iii) slips (iv) p.f. (v) Efficiency.
9. To Plot V-Curve and inverted V-Curve of synchronous motor.
10. To synchronize an alternator across the infinite bus (RSEB) and control load sharing.

4EE11A: ELECTRICAL MACHINE DESIGN (Common to EE and EX)

1. Design of transformers: output of transformer, output equation- volt per turn, core area and weight of iron & copper, optimum design—(i) minimum cost and (ii) minimum losses. Design of core and windings. Design a 3-phase transformer.
2. Design of rotating machines: General concepts. specific loading, output equations –dc machines and ac machines, factor affecting size of rotating machines, choice of specific magnetic and electric loadings.
3. Design of 3-phase induction motors: output equation, choice of air gap flux density and ampere conductors' parameter, main dimensions. Design of a 3-phase squirrel cage induction motor.
4. Design of single phase induction motors: output equation, main dimensions, relative size of single phase and 3-phase induction motors. Design of a single phase capacitor start induction motor.
5. Design of synchronous machines: output equation, choice of specific magnetic and electric loadings, main dimensions, short circuit ratio. Design a 3-phase, 2-pole turbo alternator.

Syllabus B.Tech. (Electrical Engineering), 5th semester

5EE1A: POWER ELECTRONICS (Common for EE and EX)

B.Tech. (Electrical) 5th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Power Semiconductor Devices: Construction, Principle of operation, Characteristics and applications of Power Transistor & Thyristor.	3
	Characteristics of GTO, DIAC, MCT, TRIAC, Power MOSFET and IGBT; Two-Transistor Model of Thyristor, Thyristor Commutation methods.	5
2	SCR: Construction and characteristics, specification and ratings, pulse transformer, optical isolators, methods of turn on, triggering circuits for SCR: R, RC, UJT relaxation oscillator.	4
	Rating extension by series and parallel connections, string efficiency. Protection of SCR-Protection against over voltage, over current, dv/dt, di/dt, Gate protection.	4
3	Converters-I: Single Phase half & full wave converters with RL & RLE load, Single phase dual converters, Three phase half wave converters.	5
	Three phase full converters with RL load, Three phase dual converters.	3
4	Converters-II: Single and three-phase semi converters with RL & RLE load. Power factor improvement-Extinction angle control, symmetrical angle control, pulse width modulation control and sinusoidal pulse width modulation control.	6
	Inversion operation. Effect of load and source impedances.	2
5	DC-DC Converters: Step Up/Down Converter, Control strategies, Chopper Configurations, Analysis of type A Chopper	4
	Voltage, current and load commutated chopper. Multiphase Chopper	4

Text Books

S.No.	Name of authors'/books/publisher	Year of Pub.
1	M. D. Singh and K. B. Khanchandani: Power Electronics 2/e, MGH.	2008
2	M. H. Rashid: Power Electronics, Circuits Devices and Applications, Pearson.	2011

Reference Books

S. No.	Name of authors'/books/publisher	Year of Pub.
1	V. R. Moorthi: Power Electronics-Devices, Circuits and Industrial Applications, Oxford.	2005
2	Theodore Wildi: Electrical Machines, Drives and Power Systems, Pearson.	2007
3	Ned Mohan: Power Electronics, John Wiley.	2013
4	Krein P. T.: Elements of Power Electronics, Oxford.	1998
5	P. S. Bimbhra: Power Electronics, Khanna Publishers.	2012

5EE2A: MICROPROCESSOR AND COMPUTER ARCHITECTURE

B.Tech. (Electrical) 5th Semester
3L

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction to 8085 Microprocessor Architecture: CPU, address bus, data bus and control bus. Input/Output devices, buffers, encoders, latches and memories.	4
	Internal Data Operations and Registers, Pins and Signals, Peripheral Devices and Memory Organization, Interrupts.	4
2	8085 Microprocessor Instructions: Classification, Format and Timing.	4
	Instruction Set: 8 Bit and 16 Bit Instructions, Programming and Debugging, Subroutines.	4
3	8085 Microprocessor Interfacing: 8259, 8257, 8255, 8253, 8155 chips and their applications.	5
	A/D conversion, memory, keyboard and display interface (8279).	3
4	8086 Microprocessor: Architecture: Architecture of INTEL 8086 (Bus Interface Unit, Execution unit), register organization, memory addressing, memory segmentation, Operating Modes	6
	Instruction Set of 8086: Addressing Modes: Instruction format: Discussion on instruction Set: Groups: data transfer, arithmetic, logic string, branch control transfer, processor control. Interrupts: Hardware and software interrupts, responses and types.	2
5	Basic Computer Architecture: Central Processing Unit, memory and input/output interfacing. Memory Classification Volatile and non-volatile memory, Primary and secondary memory, Static and Dynamic memory, Logical, Virtual and Physical memory.	4
	Types Of Memory: Magnetic core memory, binary cell, Rom architecture and different types of ROM, RAM architecture, PROM, PAL, PLA, Flash and Cache memory, SDRAM, RDRAM and DDRAM. Memory latency, memory bandwidth, memory seek time.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Gaonkar, Ramesh S.: Microprocessor Architecture, programming and Applications with the 8085, Pen Ram International Publishing 5th Ed.	2002
2	K. Udaykumar and B. S. Umashankar: The 8085 Microprocessor: Architecture, Programming and Interfacing, Pearson Publisher.	2008

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1.	Douglas V. Hall: Microprocessors and Interfacing, Revised Second Edition (SIE), MGH.	2007
2.	Ray. A. K. & Burchandi, K. M.: Advanced Microprocessors and Peripherals, Architecture, Programming and Interfacing, MGH.	2006
3.	Lyla B. Das: The X 86 Microprocessors: Architecture, Programming and Interfacing (8086 to Pentium), Pearson Publisher.	2010
4.	Krishna Kant: Microprocessors and Microcontrollers, PHI Learning.	2007
5.	M. Rafiqzaman: Microprocessors-Theory and applications, PHI.	1993
6.	B. Ram: Advanced Microprocessor & Interfacing. MGH.	2000

5EE3A: CONTROL SYSTEMS (Common for EE and EX)B.Tech. (Electrical) 5th Semester
3L+1TMax. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Elements of control systems, concept of open loop and closed loop systems, Examples and application of open loop and closed loop systems, brief idea of multivariable control systems.	5
	Mathematical Modeling of Physical Systems: Representation of physical system (Electro Mechanical) by differential equations, Determination of transfer function by block diagram reduction techniques and signal flow method, Laplace transformation function, inverse Laplace transformation.	3
2	Time Response Analysis of First Order and Second Order System: Characteristic equations, response to step, ramp and parabolic inputs.	4
	Transient response analysis, steady state errors and error constants, Transient & steady state analysis of LTI systems	4
3	Control System Components: Constructional and working concept of ac servomotor, synchronous and stepper motor	5
	Stability and Algebraic Criteria: concept of stability and necessary conditions, Routh-Hurwitz criteria and limitations. Root Locus Technique: The root locus concepts, construction of root loci.	3
4	Frequency Response Analysis: Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots	5
	Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability: gain margin and phase margin, M and N Loci, Nichols chart.	3
5	The design problem and preliminary considerations lead, lag and lead-lag networks, design of closed loop systems using compensation techniques in time domain and frequency domain.	4
	Brief idea of proportional, derivative and integral controllers.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Smarjit Ghosh, Control Systems: Theory and Applications, 2/e, Pearson Publisher.	2004
2	Dhannesh N. Manik: Control System, Cengage Learning.	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	I. J. Nagrath and M. Gopal: Control Systems Engineering, 3rd Ed, New Age Publication.	2008
2	K. R. Varmah: Control Systems, MGH	2010
3	Anandnatrajan et. al.: Control Systems Engineering, 4 th ed., Scitech Pub.	2013
4	K. Ogata: Modern Control Engineering, Prentice Hall of India.	2010
5	Norman S. Nise: Control System Engineering, John Wiley & Sons.	2011
6	Richard C. Dorf, Robert H. Bishop: Modern Control Systems, Prentice-Hall	2000
7	Robert H. Bishop: Modern Control Systems, Boyd and Fraser pub	2000

5EE4A: DATA BASE MANGEMENT SYSTEM (Common for EE and EX)B.Tech. (Electrical) 5thSemester
3LMax. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction, need, purpose and goals of DBMS. DBMS Architecture, Concept of keys, Generalization and specialization,	4
	Introduction to relational data model, ER modeling, concept of ER diagram	4
2	Database Design: Conceptual Data Base design. Theory of normalization, Primitive and composite data types, concept of physical and logical databases,	3
	Data abstraction and data independence, relational algebra and relational calculus.	5
3	SQL, DDL and DML. Constraints assertions, views database security. Application Development using SQL: Host Language interface embedded SQL programming.	5
	GL's, Forms management and report writers. Stored procedures and triggers. Dynamic SQL, JDBC.	3
4	Internal of RDBMS: Physical data organization in sequential, indexed, random and hashed files. Inverted and multi-list structures	8
5	(i) Transaction Management: Transaction concept, transaction state, serializability, conflict serializability, views serializability. (ii) Concurrency Control: Lock based protocol.	4
	(iii) Deadlock Handling: Prevention detection, recovery. (iv) Recovery System: Log based recovery.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Silverschatz Korth and Sudarshan: Database System Concepts, 6th ed., MGH.	2011
2	Raghu Rama Krishnan: Database Management Systems, 2nd ed., MGH.	2003

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	S. K Singh: Database System Concepts, Designs and Applications, Pearson Education	2011
2	Elmasari: Fundamentals of Data Base Systems, Pearson Education.	2003
3	G. K. Gupta: Database Management Systems, MGH.	2011
4	Date C. J.: An Introduction To Database System, Addition Wesley.	2003
5	Alex Berson & Stephen J. Smith: Data Warehousing, Data Mining & OLAP, MGH.	2011
6	Mallach: Data Warehousing System, MGH.	2003
7	Majumdar & Bhattacharya: Database Management System, MGH.	2011

5EE5A: TRANSMISSION & DISTRIBUTION OF ELECTRICAL POWER (Common for EE and EX)B.Tech. (Electrical) 5thSemester
3L+1TMax. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Supply systems: Basic network of power system. Transmission and distribution voltage, effect of system voltage on size of conductor and losses. Comparison of DC 2- wire, DC 3-wire, 1-phase AC and 3-phase AC (3-wire and 4-wire) systems.	5
	Distribution Systems: Primary and secondary distribution systems, feeder, distributor and service mains. Radial and ring- main distribution systems. Kelvin's law for conductor size.	3
2	Mechanical Features of Overhead Lines: Conductor material and types of conductor. Conductor arrangements and spacing.	4
	Calculation of sag and tension, supports at different levels, effect of wind and ice loading, stringing chart and sag template. Conductor vibrations and vibration dampers.	4
3	Parameters of Transmission Lines: Resistance inductance and capacitance of overheadlines, effect of earth, line transposition. Geometric mean radius and distance.	4
	Inductance and capacitance of line with symmetrical and unsymmetrical spacing Inductance and capacitance of double circuit lines. Skin and proximity effects.Equivalent circuits and performance of short and medium transmission lines.	4
4	Generalized ABCD Line Constants: equivalent circuit and performance of long transmission line. Ferranti effect. Interference with communication circuits. Power flow through atransmission line	6
	Corona: Electric stress between parallel conductors. Disruptive critical voltage and visual critical voltage, Factors affecting corona. Corona power loss. Effects of corona.	2
5	Insulators: Pin, shackle, suspension, post and strain insulators. Voltage distribution acrossan insulator string, grading and methods of improving string efficiency.	4
	Underground Cables: Conductor, insulator, sheathing and armoring materials. Types of cables. Insulator resistance and capacitance calculation. Electrostatic stresses and reduction of maximum stresses. Causes of breakdown. Thermal rating of cable. Introduction to oil filled and gas filled cables.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	S. Sivanagaraju and S. Satyanarayana: Electric Power Transmission and Distribution, Pearson Publisher.	2008
2	A. S. Pabla: Electric Power Distribution, MGH.	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	B. R. Gupta: Power System Analysis & Design, S. Chand Publishers.	2008
2	Soni, Gupta and Bhatnagar: A Course in Electrical Power, Dhanpat Rai.	1987
3	C. L. Wadhwa: Electrical Power Systems, New Age.	2009
4	Nagrath Kothari: Modern Power System Analysis, MGH.	2011
5	J. J. Grainger & W. D. Stevenson: Power System Analysis, MGH.	2003
6	Kamaraju: Electrical Power Distribution Systems, MGH.	2009

5EE6.1A: OPTIMIZATION TECHNIQUES**B.Tech. (Electrical) 5thSemester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Engineering application of Optimization, Formulation of design problems as mathematical programming problems, classification of optimization problems.	8
2	Optimization Techniques: Classical optimization, multivariable with no constraints, unconstrained minimization techniques,	4
	Penalty function techniques, Lagrange multipliers and feasibility techniques.	4
3	Linear Programming: Graphical method, Simplex method, Duality in linear programming (LP), Sensitivity analysis Applications in civil engineering.	5
4	Non Linear Programming Techniques/Method: Unconstrained optimization, one dimensional minimization, golden section, elimination, quadratic and cubic, Fibonacci, interpolation	6
	Direct search, Descent, Constrained optimization, Direct and indirect, Optimization with calculus, Khun-Tucker conditions.	2
5	Constrained Optimization Techniques: Direct, complex, cutting plane, exterior penalty function methods for structural engineering problems.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Rao S. S.: Engineering Optimization- Theory and Practice, New Age International.	2009
2	Hadley. G.: Linear programming, Narosa Publishing House, New Delhi.	2003

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Deb. K.: Optimization for Engineering Design- Algorithms and Examples, PHI.	2012
2	Bhavikatti S. S.: Structural Optimization Using Sequential Linear Programming, Vikas Publishing House, New Delhi.	2003
3	Spunt: Optimum Structural Design, Prentice Hall.	1971
4	Uri Krusch: Optimum Structural Design, MGH.	1981

5EE6.2A: PRINCIPLE OF COMMUNICATION SYSTEMS (Common for EE and EX)**B.Tech. (Electrical) 5thSemester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Noise Effects in Communication Systems: Resistor noise, Networks with reactive elements, Noise temperature, Noise bandwidth, effective input noise temperature,	2
	Noise figure. Noise figure & equivalent noise temperature in cascaded circuits.	6
2	Amplitude Modulation: Frequency translation, Recovery of base band signal, Spectrum & power relations in AM systems.	4
	Methods of generation & demodulation of AM-DSB, AMDSB/SC and AM-SSB signals. Modulation & detector circuits for AM systems. AM transmitters & receivers.	4
3	Frequency Modulation: Phase & freq. modulation & their relationship, Spectrum & bandwidth of a sinusoidally modulated FM signal, phasor diagram, Narrow band & wide band FM. Generation & demodulation of FM signals.	5
	FM transmitters & receivers, Comparison of AM, FM & PM. Pre emphasis & de-emphasis. Threshold in FM, PLL demodulator.	3
4	Noise in AM and FM: Calculation of signal-to-noise ratio in SSB-SC, DSB-SC, DSB with carrier, Noise calculation of square law demodulator & envelope detector.	6
	Calculation of S/N ratio in FM demodulators, Super-heterodyne receivers.	2
5	Pulse Modulation Systems: Sampling theorem, Generation and demodulation methods of PAM, PWM, PPM.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	John G. Proakis, and Masoud Salehi: Fundamentals of Communication Systems, Pearson Publisher.	2007
2	P. Ramakrishna Rao: Communication Systems, MGH.	2013

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	V. Chandra Sekar: Communication Systems, Oxford.	2006
2	Taub and Schilling: Principles of Communication Systems 3/e, MGH.	2008
3	B. P. Lathi: Modern Analog & Digital Communication System, 4 th ed., Oxford.	2009
4	Simon Hykin: Communication Systems, John Wiley and Sons.	2008
5	R. P. Singh and S. D. Sapre: Communication System Analog & Digital 2/e, MGH.	2008
6	G. Kennedy and B. Davis: Electronic Communication Systems, MGH.	1993
7	Roy Blake: Wireless Communication Technology, Thomson Asia Pvt. Ltd. Singapore.	2008

5EE6.3A INTRODUCTION TO VLSI (Common for EE and EX)B.Tech. (Electrical) 5th semester
3L+1TMax. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction to MOS Technology: Basic MOS transistors, Enhancement Mode transistor action, Depletion Mode transistor action, NMOS and CMOS fabrication.	8
2	Basic Electrical Properties of MOS Circuits: I_{DS} versus V_{DS} relationship, Aspects of threshold voltage, Transistor Trans conductance gm.	4
	The NMOS inverter, Pull up to Pull-down ratio for a NMOS Inverter and CMOS Inverter (B_n/B_p), MOS transistor circuit Model, Noise Margin.	4
3	CMOS Logic Circuits: The inverter, Combinational Logic, NAND Gate NOR gate, Compound Gates, 2 input CMOS Multiplexer, Memory latches and registers	5
	Transmission Gate, Gate delays, CMOS-Gate Transistor sizing, Power dissipation	3
4	Basic Physical Design of Simple Gates and Layout Issues: Layout issues for inverter, Layout for NAND and NOR Gates,	6
	Complex Logic gates Layout, Layout optimization for performance.	2
5	Introduction to VHDL, Verilog & other design tools. VHDL Code for simple Logic gates, flip-flops, shift-registers, Counters, Multiplexers, adders and subtractors.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	S. M. Sze: VLSI Technology, MGH.	2003
2	Debaprasad Das: VLSI Design, Oxford.	2011

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Angsuman Sarkaret. al.: VLSI Design and EDA Tools, Scitech Pub.	2011
2	S. M. Kang: CMOS Digital Integrated Circuits, MGH.	2003
3	Stephen A. Campbell: The Science & Engineering of Microelectronic Fabrication, Oxford.	2001
4	James D. Plummer, Micheal Deal & Petter B. Griffin: Silicon VLSI Tech. Fundamental Practice & Modeling, Prentice Hall.	2000

5EE7A: POWER ELECTRONICS LAB (Common for EE and EX)

- 1 Study the comparison of following power electronics devices regarding ratings, performance characteristics and applications: Power Diode, Power Transistor, Thyristor, Diac, Triac, GTO, MOSFET, MCT and SIT.
- 2 Determine V-I characteristics of SCR and measure forward breakdown voltage, latching and holding currents.
- 3 Find V-I characteristics of TRIAC and DIAC.
- 4 Find output characteristics of MOSFET and IGBT.
- 5 Find transfer characteristics of MOSFET and IGBT.
- 6 Find UJT static emitter characteristics and study the variation in peak point and valley point.
- 7 Study and test firing circuits for SCR-R, RC and UJT firing circuits.
- 8 Study and test 3-phase diode bridge rectifier with R and RL loads. Study the effect of filters.
- 9 Study and obtain waveforms of single-phase half wave controlled rectifier with and without filters. Study the variation of output voltage with respect to firing angle.
- 10 Study and obtain waveforms of single-phase half controlled bridge rectifier with R and RL loads. Study and show the effect of freewheeling diode.
- 11 Study and obtain waveforms of single-phase full controlled bridge converter with R and RL loads. Study and show rectification and inversion operations with and without freewheeling diode.
- 12 Control the speed of a dc motor using single-phase half controlled bridge rectifier and full controlled bridge rectifier. Plot armature voltage versus speed characteristics.

Reference/Suggested Books

1. O. P. Arora: Power Electronics Laboratory-Experiments and Organization, Narosa Pub.
2. P. B. Zbar: Industrial Electronics- A Text-Lab Manual, MGH.

5EE8A: MICROPROCESSOR LAB

- 1 Study the hardware, functions, memory structure and operation of 8085-Microprocessor kit.
- 2 Program to perform integer division: (1) 8-bit by 8-bit (2) 16-bit by 8-bit.
- 3 Transfer of a block of data in memory to another place in memory
- 4 Transfer of block to another location in reverse order.
- 5 Searching a number in an array.
- 6 Sorting of array in: (1) Ascending order (2) Descending order.
- 7 Finding parity of a 32-bit number.
- 8 Program to perform following conversion (1) BCD to ASCII (2) BCD to hexadecimal.
- 9 Program to multiply two 8-bit numbers
- 10 Program to generate and sum 15 Fibonacci numbers.
- 11 Program for rolling display of message "India", "HELLO".
- 12 To insert a number at correct place in a sorted array.
- 13 Reversing bits of an 8-bit number.
- 14 Fabrication of 8-bit LED interfaces for 8085 kit through 8155 and 8255.
- 15 Data transfer on output port 8155 & 8255 & implementation of disco light, running light, and sequential lights on the above mentioned hardware.
- 16 Parallel data transfer between two DYNA-85 kit using 8253 ports.
- 17 Generation of different waveform on 8253/8254 programmable timer.

5EE9A: SYSTEM PROGRAMMING LAB (Common for EE and EX)

Basics of MATLAB matrices and vectors, matrix and array operations, Saving and loading data, plotting simple graphs, scripts and functions, Script files, Function files, Global Variables, Loops, Branches, Control flow, Advanced data objects, Multi-dimensional matrices, Structures, Applications in linear algebra curve fitting and interpolation. Numerical integration, Ordinary differential equation. (All contents is to be covered with tutorial sheets)

Simulink: Idea about simulink, problems based on simulink. (All contents is to be covered with tutorial sheets) Write a program to generate Machine Op- code table using two pass Assembler.

Reference/Suggested Books

1. Almos Gilat: MATLAB: An Introduction with Applications, Wiley India Ltd., 2004.
2. Ram N. Patel et. al.: Programming in MATLAB, Pearson.

5EE10A: DBMS LAB (Common for EE and EX)

- 1 Designing database and constraints using DDL statements.
- 2 Experiments for practicing SQL query execution on designed database.
- 3 Database connectivity using JDBC/ODBC.
- 4 Features of embedded SQL.
- 5 Designing front end in HLL and accessing data from backend database.
- 6 Designing simple projects using front end-back end programming
- 7 Project for generating Electricity Bills
- 8 Project for managing student's attendance/marks details.

5EE11A PROFESSIONAL ETHICS AND DISASTERS MANAGEMENT (Common for EE and EX)

- 1 **Objectives:** to help the students
 - To appreciate the importance and values and ethics in implementing the technology and ensure sustainable development, happiness and prosperity.
 - To understand the co-existence with nature and to be aware of potential natural and manmade disasters.
- 2 **Human Values:** Effect of Technological Growth and Sustainable Development. Profession and Human Values: Values crisis in contemporary society. Nature of values. Psychological Values, Societal Values and Aesthetic Values. Moral and Ethical values.
- 3 **Professional Ethics:**
 - Professional and Professionalism-Professional Accountability, Role of a professional, Ethic and image of profession.
 - Engineering Profession and Ethics-Technology and society, Ethical obligations of Engineering professionals, Roles of Engineers in industry, society, nation and the world.
 - Professional Responsibilities-Collegiality, Loyalty, Confidentially, Conflict of Interest, Whistle Blowing.
- 4 **Disaster Management:** Understanding Disasters and Hazards and related issues social and environmental. Risk and Vulnerability. Types of Disasters, their occurrence/ causes, impact and preventive measures:
Natural Disasters- Hydro-meteorological Based Disasters like Flood, Flash Flood, Cloud Burst, Drought, Cyclone, Forest Fires; Geological Based Disasters like Earthquake, Tsunami, Landslides, Volcanic Eruptions.
- 5 **Manmade Disasters:** Chemical Industrial Hazards, Major Power Break Downs, Traffic Accidents, Fire Hazards, Nuclear Accidents. Disaster profile of Indian continent. Case studies. Disaster Management Cycle and its components.
In order to fulfill objectives of course,
(A) The institute shall be required to organize at least 3 expert lectures by eminent social workers/professional leaders.
(B) Each student shall compulsorily be required to:
I. Visit a social institution/NGO for at least 7 days during the semester and submit a Summary report.
II. Perform a case study of a disaster that has occurred in last decade and submit a Summary report.

Reference/Suggested Books

1. R Subramanian: Professional Ethics, oxford publishers.
2. Engineering Ethics: Concepts and cases by Charles E. Harris, Jr., Michael S. Pritchard, Michael J. Rabins. Cengage Learning, Delhi
3. Stephen H. Unger: Controlling Technology- Ethics and Responsible Engineers, John Willey and Sons.
4. Deborah Johnson: Ethical Issues in Engineering, Prentice Hall.
5. A. N. Tripathi: Human Values in the engineering Profession, Moniograph, Published by IIM Calcutta.
6. D. K. Sinha: Towards Basics of Natural Disaster Reduction, Researchco Book Center, Delhi.
7. Amita Sinval: Understanding Earthquake Disasters, MGH, New Delhi.
8. Selected Resources available on www.nidmindia.nic.in

Syllabus B.Tech. (Electrical Engineering), 6th semester

6EE1A: MODERN CONTROL THEORY (Common for EE and EX)

B.Tech. (Electrical) 6th semester

Max. Marks: 80

3L+1T

Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Concept of Linear vector space Linear Independence, Bases & Representation, domain and range. Concept of Linearity, relaxedness, time invariance, causality.	5
	State Space Approach of Control System Analysis: Modern Vs conventional control theory, concept of state, state variable state vector, state space, state space equations, Writing statespace equations of mechanical, Electrical systems, Analogous systems.	3
2	State Space Representation using physical and phase variables, comparison form of system representation. Block diagram representation of state model. Signal flow graph representation.	5
	State space representation using canonical variables. Diagonal matrix. Jordan canonical form, Derivation of transfer functions from state-model.	3
3	Solution of State Equations: Eigenvalues and Eigen vectors. Matrix.Exponential, State transition matrix, Properties of state transition matrix.	4
	Computation of State transition matrix concepts of controllability & observability, Pole placement by state feedback.	4
4	Digital Control Systems: Introduction, sampled data control systems, signal reconstruction, difference equations.	4
	The z-transform, Z-Transfer Function. Block diagram analysis of sampled data systems, z and s domain relationship.	4
5	Modeling of sample-hold circuit, steady state accuracy, stability in z-plane and Jury stability criterion, bilinear transformation	4
	Routh-Hurwitz criterion on s-planes, digital PID controllers, Introduction to adaptive control.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	I. J. Nagrath and M. Gopal: Control Systems Engineering, 3rd Ed, New Age Publication.	2008
2	S. K. Bhattacharya: Control Systems Engineering, 3e, Pearson Publishers.	2009

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Dhannesh N. Manik: Control System, Cengage Learning.	2010
2	Richard C. Dorf, Robert H. Bishop: Modern Control Systems, Prentice-Hall.	2008
3	M. Gopal: Digital Control and State Variable Methods, MGH.	2012
4	B. C. Kuo: Digital Control System, Oxford.	1980
5	C. H. Houpis and G. B. Lamont, Digital Control Systems, MGH.	1992
6	Donald E. Kiv: Optimal Control Theory- An Introduction, Prentice Hall.	2009
7	D. Roy, Choudhary: Modern Control Engineering, Prentice Hall of India.	2005
8	C. T. Chen: System Theory & Design, Oxford University Press.	1999

6EE2A HIGH VOLTAGE ENGINEERING

B.Tech. (Electrical) 6th semester
3L

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	(i) Breakdown in Gases: Introduction to mechanism of breakdown in gases, Townsend's breakdown mechanism. Breakdown in electromagnetic gases, Application of gases in power system.	4
	(ii) Breakdown in Liquids: Introduction to mechanism of breakdown in liquids, suspended solid particle mechanism and cavity breakdown. Application of oil in power apparatus.	4
	(iii) Breakdown in solids: Introduction to mechanism of breakdown in solids, electromechanical breakdown, treeing & tracking breakdown and thermal breakdown	4
2	(i) High DC Voltage Generation: Generation of high dc voltage, basic voltage multiplier circuit.	5
	(ii) High AC Voltage Generation: Cascaded Transformers.	3
	(iii) Impulse Voltage generation: Impulse voltage, basic impulse circuit, Mark's multistage impulse generator.	3
3	(iv) Measurement of High Voltage: Potential dividers - resistive, capacitive and mixed potential dividers. Sphere gap- Construction and operation. Klydonograph.	3
	Nondestructive Insulation Tests: (i) Measurement of resistivity, dielectric constant and loss factor. High Voltage Schering Bridge- measurement of capacitance and dielectric loss.	5
4	(ii) Partial Discharges: Introduction to partial discharge, partial discharge equivalent circuit. Basic wide-band and narrow band PD detection circuits.	6
	(i) Over voltages: Causes of over voltages, introduction to lightning phenomena, over voltages due to lightning.	2
5	(ii) Travelling Waves: Travelling waves on transmission lines-open end line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at a T-junction and line terminated through a capacitance. Attenuation of traveling waves.	6
	(i) Over Voltage Protection: Basic construction and operation of ground wires-protection angle and protective zone, ground rods, counterpoise, surge absorber, rod gap and arcing horn, lightning arresters - expulsion type, non -linear gap type and metal oxide gapless type.	5
	(ii) Insulation Coordination: Volt-time curves, basic impulse insulation levels, coordination of insulation levels	3

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Naidu: High Voltage Engineering 4/e, MGH.	2013
2	John Kuffel, E. Kuffel and W. S. Zaengl: High Voltage engineering, Elsevier.	2000

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	C. L.Wadhwa: High Voltage Engineering, Wiley Eastern Ltd.	2007
2	Subir Ray: An Introduction to High Voltage Engineering, Prentice Hall of India.	2013

6EE3A: SWITCHGEAR & PROTECTION (Common for EE and EX)

B.Tech. (Electrical) 6th semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Static Relays: Introduction to static relays, merits and demerits. Comparators: amplitude and phase comparators, duality between amplitude and phase comparators. Introduction to (a) amplitude comparators-circulating current type, phase splitting type and sampling type, (b) phase comparators-vector product type and coincidence type.	6
	Static Over Current Relays: Introduction to instantaneous, definite time, inverse time and directional overcurrent relays.	2
2	Static Differential Relays: Brief description of static differential relay schemes-single phase and three phase schemes. Introduction to static differential protection of generator and transformer.	5
	Static Distance Relays: Introduction to static impedance, reactance and mho relays.	3
3	Carrier Current Protection: Basic apparatus and scheme of power line carrier system. Principle of operation of directional comparison and phase comparison carrier protection and carrier assisted distance protection.	4
	Distance Protection: Effect of power swings on the performance of distance protection. Out of step tripping and blocking relays, mho relay with blinders. Introduction to quadrilateral and elliptical relays.	4
4	Circuit Breakers-I: Electric arc and its characteristics, arc interruption-high resistance interruption and current zero interruption. Arc interruption theories-recovery rate theory and energy balance theory.	4
	Restriking voltage and recovery voltage, develop expressions for restriking voltage and RRRV. Resistance switching, current chopping and interruption of capacitive current. Oil circuit breakers-bulk oil and minimum oil circuit breakers. Air circuit breakers. Miniature Circuit breaker (MCB).	4
5	Circuit Breakers-II: Air blast, SF6 and vacuum circuit breakers. Selection of circuit breakers, rating of circuit breakers.	4
	Digital Protection: Introduction to digital protection. Brief description of block diagram of digital relay. Introduction to digital overcurrent, transformer differential and transmission line distance protection.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Bhavesh Bhalja, R. P. Maheshari and Nilesh G. Chothani: Protection and Switchgear, Oxford.	2011
2	Bhuvanesh A. Oza and Nair: Power System Protection and Switchgear, MGH.	2010

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	B. Ravindranath and M. Chander: Power system Protection and Switchgear, Wiley.	1977
2	B. Ram and D. N. Vishwakarma: Power System Protection and Switchgear, MGH.	2001
3	Y. G. Paithankar and S. R. Bhide: Fundamentals of Power System Protection, PHI.	2010
4	T.S.M. Rao: Power System Protection- Static Relays with Microprocessor Applications, MGH.	1989
5	A. R. Van C. Warrington: Protective Relays-Their Theory and Practice, Vol. I & II, Jhon Willey & Sons.	1978
6	S. S. Rao: Switchgear and Protection, Khanna Publishers.	2008

6EE4A: ADVANCED POWER ELECTRONICS (Common for EE and EX)**B.Tech. (Electrical) 6th semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	AC Voltage Controllers: Principle of On-Off Control, Principle of Phase control, SinglePhase Bi-directional Controllers with Resistive Loads, Single Phase Controllers with Inductive Loads, Three Phase full wave AC controllers, AC Voltage Controller with PWM Control.	5
2	Cyclo-converters: Basic principle of operation, single phase to single phase, three-phase to three-phase and three-phase to single phase cyclo-converters. Output equation, Control circuit.	8
3	Inverters: Principle of Operation, Single-phase bridge inverters. Three phase bridge Inverters: 180 and 120 degree of conduction. VSI and CSI.	6
	Voltage control of Single Phase and Three Phase Inverters, Harmonic analysis,harmonic reduction techniques,Pulse width modulation techniques.	5
4	Resonant Pulse Inverter: Series resonant inverter with unidirectional switches, parallel resonant inverter, class E resonant inverter, L-type and M-type ZCS resonant converter, ZVS resonant converter.	8
5	Power Supplies: Switched Mode DC Power Supplies, fly-back converter, forward converter, half and full bridge converter, resonant DC power supplies, bi-directional power supplies.	4
	Resonant AC power supplies, bidirectional AC power supplies. Multistage conversions, Control Circuits: Voltage Mode Control, Current Mode Control	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. H. Rashid: Power Electronics: Circuits, Devices & Applications, Pearson Publishers.	2004
2	Bimal Bose: Power Electronics & Motor Drives, Elsevier-2006.	2010

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	V. R. Moorthy: Power Electronics: Devices, Circuits and Industrial Applications, Oxford.	2005
2	P. C. Sen: Power Electronics, MGH.	1987
3	Ned Mohan, T. M. Undeland and W. P. Robbins: Power Electronics- Converters, Applications and Design, Wiley India Ltd, 2008.	2007
4	R. Krishnan: electric motor drives- modeling, analysis and control, Pearson Edu.	2001

6EE5A: SMART GRID TECHNOLOGY

B.Tech. (Electrical) 6th semester
3L

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction to Smart Grid: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits	5
	Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid, Diverse perspectives from experts and global Smart Grid initiatives.	3
2	Smart Grid Technologies: Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring,	5
	Protection and Control, Distribution Systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).	3
3	Smart Meters and Advanced Metering Infrastructure: Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives,	4
	AMI needs in the smart grid, Phasor Measurement, Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.	4
4	Power Quality Management in Smart Grid: Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources,	5
	Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.	3
5	High Performance Computing for Smart Grid Applications: Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL),	4
	IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke: Smart Grid Technologies- Communication Technologies and Standards IEEE Transactions on Industrial Informatics, Vol. 7, No. 4, November 2011.	2011
2	Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang: Smart Grid – The New and Improved Power Grid- A Survey, IEEE Transaction on Smart Grids,	2011

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press	2012

6EE6.1A: ADVANCED MICROPROCESSORS**B.Tech. (Electrical) 6th semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	8086 Microprocessor: Hardware specifications, architecture, address spaces, clock generator, bus controller and arbiter, Minimum and maximum mode, System Bus Timing.	8
2	Software & Instruction Set: Assembly language programming: addressing mode and instructions of 8086, linking and execution of programs, MACRO programming, assembler directives and operators.	8
3	I/O Interfaces: Programmable peripheral interfacing (8255, 8155), Programmable Timer interfacing (8253, 8254), Programmable interrupt controller (8259), Serial Communication Interfaces.	8
4	Data & Memory Interfacing: A/D, D/A converter interfacing, Memory interfacing and Decoding, DMA controller.	8
5	Multiprocessor Configurations: 8086 based Multiprocessor systems. 8087 Numeric data processor. Introduction to 8-bit and 16-bit microcontrollers.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	A. Nagoor Kani: Microprocessors and Microcontrollers, 2 nd ed., MGH.	2012
2	N. Senthil Kumar and Saravanan: Microprocessors and Interfacing, Oxford.	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	John Freer: System design with Advance Microprocessors, A.H. Wheeler	1987
2	Ray & Bhurchandi: Advanced Microprocessors and Peripherals 2/e (MGH)	2006
3	Lyla B. Das: The X 86 Microprocessors- Architecture, Programming and Interfacing (8086 to Pentium), Pearson Publisher.	2010
4	Gibson: 16-Bit Microprocessor.	
5	Brey: 16-Bit Microprocessor	2009
6	Ray, A. K. & Burchandi, K. M.: Advanced Microprocessors and Peripherals- Architecture, Programming and Interfacing, MGH.	2006
7	Brey, Barry B.: The INTEL Microprocessors, Pearson Education.	2011
8	Ayala: The 8051 Micro Controller, Cengage Learning.	2004

6EE6.2A: POWER SYSTEM INSTRUMENTATION(Common for EE and EX)B.Tech. (Electrical) 6th semester
3L+1TMax. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Theory of Errors: Accuracy and precision, systematic and random errors, limits of error, probable error and standard deviation. Gaussian error curves, combination of errors.	8
2	Transducers: Construction & Operating Characteristics of active and digital transducers, Measurement of temperature, pressure, displacement, acceleration, noise level.	4
	Instrumentation for strain, displacement, velocity, acceleration, force, torque and temperature.	4
3	Signal Conditioning: Instrumentation amplifiers, isolation amplifiers, analog multipliers, analog dividers, function generators, timers, sample and hold, optical and magnetic isolators.	5
	Frequency to voltage converters, temperature to current converters. Shielding and grounding.	3
4	Power System Instrumentation-I: Measurement of voltage, current, phase angle, frequency, active power and reactive power in power plants. Energy meters and multipart tariff meters. Basic idea of LT & HT panel's.	8
5	Power System Instrumentation-II: Capacitive voltage transformers and their transient behavior, Current Transformers for measurement and protection, composite errors and transient response.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	R. H. Cerni and L. E. Foster: Instrumentation for Engineering Measurements, John Wiley and Sons.	1962
2	Curtis and D. Hohnson: Process Control Instrumentation Technology, John Wiley and sons.	2013

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	R. Morrison: Instrumentation Fundamentals and Applications, John Wiley and Sons.	1984
2	A. K. Sawhney: Advanced Measurements & Instrumentation, Dhanpat Rai & Sons.	1994
3	E.O. Decblin: Measurement System– Application & design, MGH.	1975
4	W.D. Cooper and A.P. Beltried: Electronics Instrumentation and Measurement Techniques, Prentice Hall International.	1987
5	A. S. Moris: Principles of Measurement & Instrumentation, Prentice Hall	1993

6EE6.3A: DIGITAL COMMUNICATION AND INFORMATION THEORY(Common for EE and EX)**B.Tech. (Electrical) 6th semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	PCM & Delta Modulation Systems: PCM and delta modulation, quantization noise in PCM and delta modulation. Signal-to-noise ratio in PCM and delta modulation,	4
	T1 Carrier System, Comparison of PCM and DM. Adaptive delta Modulation. Bit, word and frame synchronization, Matched filter detection.	4
2	Digital Modulation Techniques: Various techniques of phase shift, amplitude shift and frequency shift keying. Minimum shift keying. Modulation & Demodulation.	8
3	Error Probability in Digital Modulation: Calculation of error probabilities for PSK, ASK, FSK & MSK techniques.	8
4	Information Theory: Amount of Information, Average Information, Entropy, Information rate, Increase in Average information per bit by coding, Shannon's Theorem and Shannon's bound	4
	Capacity of a Gaussian Channel, BW-S/N trade off, Orthogonal signal transmission.	4
5	Coding: Coding of Information, Hamming code, Single Parity-Bit Code, Linear Block code, cyclic code & convolution code.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	R. N. Mutagi: Digital Communication, 2 nd ed., Oxford.	2013
2	P. Ramakrishna Rao: Communication Systems, MGH.	2013

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	H. Taub & D.L. Schilling: Principles of Communication Systems, MGH.	2008
2	Simon Haykin: Communication Systems, John Wiley & Sons.	2008
3	Proakis: Digital Communication, MGH.	2008
4	Sklar: Digital Communication, Pearson Education.	2009
5	P. Chakrabarti: Principles of Digital Communications, Danpatrai & Sons.	1999
6	K. Sam Shanmugam: Digital and Analog Communication System, John Wiley Sons.	2006
7	Lathi, B. P.: Modern Digital & Analog Communication System, Oxford Press.	2009
8	A.B. Carlson: Digital Communication Systems, MGH.	1988

6EE7A: CONTROL SYSTEM LAB (Common for EE and EX)

- 1 Introduction to MATLAB Computing Control Software.
- 2 Defining Systems in TF, ZPK form.
- 3 (a) Plot step response of a given TF and system in state-space. Take different values of damping ratio and w_n natural undamped frequency.
(b) Plot ramp response.
- 4 For a given 2nd order system plot step response and obtain time response specification.
- 5 To design 1st order R-C circuits and observe its response with the following inputs and trace the curve.
(a) Step
(b) Ramp
(c) Impulse
- 6 To design 2nd order electrical network and study its transient response for step input and following cases.
(a) Under damped system
(b) Over damped System.
(c) Critically damped system.
- 7 To Study the frequency response of following compensating Networks, plot the graph and find out corner frequencies.
(a) Log Network
(b) Lead Network
(c) Log-lead Network.
- 8 To draw characteristics of ac servomotor
- 9 To perform experiment on Potentiometer error detector.
- 10 Check for the stability of a given closed loop system.
- 11 Plot bode plot for a 2nd order system and find GM and PM.

6EE8A: POWER SYSTEM LAB (Common for EE and EX)

- 1 Study the burden effect on the performance of CT and measure ratio error.
- 2 Find out the sequence components of currents in three 1-Phase transformers and 3-Phase transformer and compare their results.
- 3 (i) Study over current relay.
(ii) Draw the current-time characteristic of an over current relay for TMS=1 & 0.5 and PSM=1.25 & 1.0.
- 4 (i) Study percentage bias differential relay.
(ii) Plot the characteristics of a percentage bias differential relay for 20%, 30% and 40% biasing.
- 5 Study gas actuated Buchholz relay.
- 6 Study under frequency relay and check its setting experimentally.
- 7 Design a HV transmission line.
- 8 Study a typical grid substation.
- 9 Study earthing of power station, substation and building

6EE9A: ADVANCED POWER ELECTRONICS LAB (Common for EE and EX)

- 1 Study and test AC voltage regulators using triac, antiparallel thyristors and triac&diac.
- 2 Study and test single phase PWM inverter.
- 3 Study and test buck, boost and buck- boost regulators.
- 4 Study and test MOSFET chopper.
- 5 Study and test Zero voltage switching.
- 6 Study and test SCR DC circuit breaker.
- 7 Control speed of a dc motor using a chopper and plot armature voltage versus speed characteristic.
- 8 Control speed of a single-phase induction motor using single phase AC voltage regulator.
- 9 (i) Study single-phase dual converter.
(ii) Study speed control of dc motor using single-phase dual converter.
- 10 Study one, two and four quadrant choppers (DC-DC converters).
- 11 Study speed control of dc motor using one, two and four quadrant choppers.
- 12 Study single-phase cycloconverter.

6EE10A: SMART GRID LAB

1. Study different components of smart grid
2. To visit thermal/nuclear power plant
3. To design and simulate hybrid wind-solar power generation system using simulating software
4. Study Different terminology used in power quality assessment
5. Study and measure certain parameters of power quality in laboratory with and without power quality improvement devices.

6EE11A: ENTREPRENEURSHIP DEVELOPMENT (Common for EE and EX)

- 1 Definition of entrepreneur, qualities of a successful entrepreneur, Charms of being an entrepreneur, achievement- motivation, leadership and entrepreneurial competencies.
- 2 Decision-making, procedures and formalities for starting own business, financial support system.
- 3 Identification and selection of business opportunities and market survey, business plan. Implementation and customer satisfaction.
- 4 Business crises, problem-solving attitude, communication skill. Government policies for entrepreneurs.
- 5 Knowledge based enterprises, Scope of entrepreneur in present context, area of future entrepreneurship.
- 6 Marketing & Sales Promotion, Techno-Economic Feasibility Assessment by Preparation of Preliminary & Detailed project report.

Syllabus B.Tech. (Electrical Engineering), 7th semester

7EE1A: POWER SYSTEM PLANNING (Common for EE and EX)

B. Tech. (Electrical) 7th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction of power planning, National and Regional Planning, structure of P.S., planning tools	4
	Electricity Regulation, Electrical Forecasting, forecasting techniques modeling.	4
2	Generation planning, Integrated power generation cogeneration/captive power, Power pooling and power trading. Transmission and distribution planning.	4
	Power system Economics. Power sector finance, financial planning, private participation Rural Electrification investment, concept of Rational tariffs.	4
3	Power supply Reliability, Reliability planning. System operation planning, load management, load prediction, reactive power balance	4
	Online power flow studies, state estimation, computerized management, power system simulator.	4
4	Computer aided planning, wheeling. Environmental effects, the greenhouse effect	4
	Technological impacts. Insulation coordination. Reactive compensation.	4
5	Optimal power system expansion planning : Formulation of least cost optimization problem incorporating the capital,	3
	Operating and maintenance cost of candidate plants of different types (Thermal, Hydro, Nuclear, Non-conventional etc.) and minimum assured reliability constraint – optimization techniques for solution by programming.	5

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	X. Wang, J. R. Mc Donald: Modern Power System Planning, MGH.	1994
2	A. S. Pabla: Electrical Power System Planning, Machmillan India Ltd.	2012

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	M. Tllic, F. Faliana and L. Fink: Power System Restructuring Engineering and Economics, Kulwar Academic Publisher.	2010
2	L. L. Lie: Power System Restructuring and Deregulation, John Willey & Sons UK.	2001

7EE2A: POWER SYSTEM ANALYSIS (Common for EE and EX)

B. Tech. (Electrical) 7th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Percent and per unit quantities. Single line diagram for a balanced 3-phase system	4
	Admittance Model: Branch and node admittances Equivalent admittance network and calculation of Y bus. Modification of an existing Y bus.	4
2	Impedance Model: Bus admittance and impedance matrices. Thevenin's theorem and Z bus. Direct determination of Z bus. Modification of an existing bus.	3
	Symmetrical fault Analysis: Transient on a Transmission line, short circuit of a synchronous machine on no load, short circuit of a loaded synchronous machine. Equivalent circuits of synchronous machine under sub transient, transient and steady state conditions. Selection of circuit breakers, Algorithm for short circuit studies. Analysis of three-phase faults.	5
3	Symmetrical Components: Fortescue theorem, symmetrical component transformation. Phase shift in star-delta transformers. Sequence Impedances of transmission lines, Synchronous Machine and Transformers, zero sequence network of transformers and transmission lines. Construction of sequence networks of power system.	4
	Fault Analysis: Analysis of single line to ground faults using symmetrical components, connection of sequence networks under the fault condition.	4
4	Unsymmetrical Fault Analysis: (i) Analysis of line-to-line and double line to ground faults using symmetrical components, connection of sequence networks under fault conditions.	5
	Analysis of unsymmetrical shunt faults using bus impedance matrix method.	3
5	Load Flow Analysis: Load flow problem, development of load flow equations, bus classification	4
	Gauss Seidel, Newton Raphosn, decoupled and fast decoupled methods for load flow analysis. Comparison of load flow methods.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	J. J. Grainger, William, D. Stevenson Jr.: Power System Analysis, MGH.	2003
2	T. K. Nagsarkar & M. S. Sukhija: Power System Analysis, Oxford University Press.	2007

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	J. D. Glover, M. S. Sharma & T. J. Overbye: Power System Analysis and Design, Cengage Learning.	2007
2	Nasser Tleis: Power System Modelling and Fault Analysis, Elsevier.	2007
3	Kothari & Nagrath: Modern Power System Analysis, MGH.	2011
4	Haadi Saadat: Power System Analysis.	2002

7EE3A: ARTIFICIAL INTELLIGENCE TECHNIQUES (Common for EE and EX)

**B. Tech. (Electrical) 7th Semester
3L**

**Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Artificial Intelligence: Introduction to AI and knowledge based Expert systems, Introduction, Importance and Definition of AI, ES, ES building tools and shells.	4
		4
2	Knowledge Representation: Concept of knowledge, Representation of knowledge using logics rules, frames. Procedural versus. Declarative knowledge, forward versus backward chaining	4
	Control Strategies: Concept of heuristic search, search techniques depth first search, Breadth first search, Generate & test hill climbing, best first search.	4
3	Artificial Neural Network: Biological Neurons and synapses, characteristics Artificial Neural Networks, types of activation functions.	4
	Perceptions: Perception representation, limitations of perceptrons. Single layer and multiplayer perceptrons. Perceptron learning algorithms.	4
4	Basic Concepts in Learning ANN: Supervised learning, Back propagation algorithm, unsupervised learning, Kohonen's top field network & Algorithm.	8
5	Fuzzy Logic: Fuzzy logic concepts, Fuzzy relation and membership functions, Defuzzification, Fuzzy controllers,	4
	Genetic Algorithm: concepts, coding, reproduction, crossover, mutation, scaling and fitness.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Saroj Kaushik: Artificial Intelligence, Cengage Learning.	2007
2	Elaine Rich and Kevin Knight: Artificial Intelligence 3/e, MGH	2004

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Padhy: Artificial Intelligence & Intelligent Systems, Oxford	2005
2	James Anderson: An introduction to Neural Networks.	1995
3	Dan. W Patterson: Artificial Intelligence and Expert Systems.	1990
4	Kumar Satish: Neural Networks, 2 nd ed., MGH.	2004
5	S. Rajsekaran & G. A. Vijayalakshmi Pai: Neural Networks, Fuzzy Logic and Genetic Algorithm- Synthesis and Applications, Prentice Hall of India.	2003
6	Siman Haykin: Neural Netowrks, Prentice Hall of India.	2004

7EE4A: NON CONVENTIONAL ENERGY SOURCES (Common for EE and EX)

**B. Tech. (Electrical) 7th Semester
3L**

**Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: World energy situation, conventional and non-conventional energy sources, Indian energy scene.	4
	Tidal Energy: Introduction to tidal power. Components of tidal power plants, double basin arrangement. Power generation. Advantages and limitations of tidal power generation. Prospects of tidal energy in India.	4
2	Solar Energy: Solar radiation, solar radiation geometry, solar radiation on tilted surface. Solar energy collector. Flat- plate collector, concentrating collector - paraboloidal and heliostat.	4
	Solar pond. Basic solar power plant. Solar cell, solar cell array, basic photo-voltaic power generating system.	4
3	Wind Energy: Basic principle of wind energy conversion, efficiency of conversion, site selection. Electric power generation-basic components, horizontal axis and vertical axis wind turbines, towers, generators, control and monitoring components. Basic electric generation schemes- constant speed constant frequency, variable speed constant frequency and variable speed variable frequency schemes. Applications of wind energy.	4
	Geothermal Energy: Geothermal fields, estimates of geothermal power. Basic geothermal steam power plant, binary fluid geothermal power plant and geothermal preheat hybrid power plant. Advantages and disadvantages of geothermal energy. Applications of geothermal energy. Geothermal energy in India.	4
4	Nuclear Fusion Energy: Introduction, nuclear fission and nuclear fusion. Requirements for nuclear fusion. Plasma confinement – magnetic confinement and inertial confinement.	4
	Basic Tokamak reactor, laser fusion reactor. Advantages of nuclear fusion. Fusion hybrid and cold fusion.	4
5	Biomass Energy: Introduction, biomass categories, bio-fuels. Introduction to biomass conversion technologies.	3
	Biogas generation, basic biogas plants-fixed dome type, floating gasholder type, Deen Bandhu biogas plant, Pragati design biogas plant. Utilization of bio gas. Energy plantation. Pyrolysis scheme. Alternative liquid fuels –ethanol and methanol. Ethanol production.	5

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	G. D. Rao: Renewable Energy	2010
2	B. H. Khan: Non-Conventional Energy Resources, MGH.	2006

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	A. N. Mathur: Non-Conventional Resources of Energy.	2010
2	Boyle: Renewable Energy, 3 rd ed Oxford.	2007
3	Bent Sorensen, 4 th ed.: Renewable Energy, Elsevier.	2009
4	V. V. N. Kishore: Renewable Energy Engineering and Technology, TERI.	2006
5	Garg & Prakash: Solar Energy : Fundamentals and Applications, MGH	2000
6	David Boyles: Bio Energy, Elis Horwood Ltd.,	1984

7	N.K. Bansal, M. Kleemann, M. Heliss: Renewable energy sources and conversion technology, MGH, 1990.	1990
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7EE5A: POWER SYSTEM ENGINEERING (Common for EE and EX)

B. Tech.(Electrical) 7th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Economic Operation of Power Systems: Introduction, system constraints, optimal operation of power systems. Input output, heat rate and incremental rate curves of thermal generating units.	3
	Economic distribution of load between generating units within a plant. Economic distribution of load between power stations, transmission loss equation. Introduction to unit commitment and dynamic programming.	5
2	Power System Stability-I: Power angle equations and power angle curves under steady state and transient conditions. Rotor dynamics and swing equation (solution of swing equation not included).	5
	Synchronizing power coefficient. Introduction to steady state and dynamic stabilities, steady state stability limit.	3
3	Power System Stability-II: Introduction to transient stability. Equal area criterion and its application to transient stability studies under basic disturbances.	4
	Critical clearing angle and critical clearing time. Factors affecting stability and methods to improve stability.	4
4	Excitation Systems: Introduction of excitation systems of synchronous machines, types of excitation systems, Elements of various excitation systems and their control (functional block diagrams and their brief description)-DC excitation systems, AC excitation systems, brushless excitation system.	4
	Interconnected Power Systems: Introduction to isolated and interconnected powers systems. Reserve capacity of power stations, spinning and maintenance reserves. Advantages and problems of interconnected power systems. Power systems inter connection in India.	4
5	Tap Changing transformer, phase angle control and phase shifting transformer. Series compensation of transmission lines, location and protection of series capacitors, advantages and problems	5
	Introduction to power system security. Introduction to voltage stability.	3

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	J. Nagrath and D.P. Kothari: Power System Engineering 2/e, MGH.	2011
2	J. J. Grainger and W. D. Stevenson: Power System Analysis, MGH.	2003

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	B. R. Gupta: Power System Analysis and Design, Third Edition, S. Chand & Co.	2008
2	C. L. Wadhwa: Electrical Power Systems, New age international Ltd. Third Edition	2009
3	W. D. Stevenson: Element of Power System Analysis, MGH.	1955
4	B. R. Gupta: Generation of Electrical Energy, S. Chand Publication.	2009

7EE6.1A: ELECTROMAGNETIC FIELD THEORY

B. Tech. (Electrical) 7th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Introduction: Vector Relation in rectangular, cylindrical, spherical and general curvilinear coordinate system.	4
	Concept and physical interpretation of gradient, Divergence and curl, Green's Stoke's and Helmholtz theorems	4
2	Electrostatics: Electric field vectors-electric field intensity, flux density & polarization. Electric field due to various charge configurations. The potential functions and displacement vector.	4
	Gauss's law, Poisson's and Laplace's equation and their solution. Uniqueness theorem. Continuity equation. Capacitance and electrostatics energy. Field determination by method of images. Boundary conditions. Field mappings and concept of field cells.	4
3	Magnetostatics: Magnetic field vector: Magnetic field intensity, flux density & magnetization, Bio-Savart's law, Ampere's law, Magnetic scalar and vector potential, self & mutual inductance.	4
	Energy stored in magnetic field, Boundary conditions, Analogy between electric and magnetic field, Field mapping and concept of field cells.	4
4	Time Varying Fields: Faraday's law, Displacement currents and equation of continuity.	4
	Maxwell's equations, Uniform plane wave in free space, dielectrics and conductors, skin effect sinusoidal time variations, reflections, refraction & polarization of UPW, standing wave ratio. Pointing vector and power considerations.	4
5	Transmission Lines: The high-frequency circuit. LCR ladder model. The transmission Lin equation. Solution for loss-less lines.	4
	Wave velocity and wave impedance. Reflection and Transmission coefficients at junctions. VSWR.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Hayt: Engineering Electromagnetics, 7/e, (With CD), MGH	2012
2	Matthew N. O. Sadiku: Principles of Electromagnetics, 4 th ed., Oxford	2009

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	G. S. N. Raju: Electromagnetic Field Theory and Transmission Lines, Pearson.	2006
2	J. D. Kraus: Electromagnetic. 5th edition, MGH.	1999
3	S. Baskaran and K. Malathi: Electromagnetic Field and Waves, Scitech Pub.	2013
4	R. S. Kshetrimayum, Electromagnetic Field Theory, Cengage Learning.	2012
5	V.V. Sarwate: Electromagnetic Field and Waves, Willey Eastern Ltd.	1993
6	Bhag Guru: Electromagnetic Field Theory Fundamentals, Cambridge Uni. Press.	2004

7EE6.2A: COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES (Common for EE and EX)**B. Tech. (Electrical) 7th Semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Basic Principles of Electrical Machine Design: Specifications, Factors affecting the design, Limitations, main dimension, loadings, output equation, factor affecting the size and rating.	4
	Electrical Engineering Materials: conducting, magnetic and insulating materials. Magnetic Circuit Calculation: Ohm's law for magnetic circuit, mmf required for air gap and iron parts, tapered teeth, real and apparent flux density, magnetizing current.	4
2	Heating and Cooling of Electrical Machines: heat dissipation and heat flow equations, Newton's law of cooling, equations for temperature rise,	4
	Rating of Machines: Continuous, short and intermittent ratings, mean temperature rise, hydrogen cooling of turbo alternators, quantity of cooling medium.	4
3	Computer Aided Design of Transformers: Power and Distribution Transformers, core and yoke cross sections, square and stepped core, output equations, main dimensions, types & design of windings, optimization concepts.	8
4	Computer Aided Design of Synchronous Machines: Turbo and Hydro alternators, choice of specific magnetic & electric loading, short circuit ratio and its effects air gap length, output equation, main dimensions, flow charts for design of synchronous machine, design of stator core & winding.	8
5	Computer Aided Design of Induction Machines: Output equation, main dimensions, design criteria, flow charts for design of induction motor, air gap length, design of stator core and winding, rotor design.	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	A. K. Sawhney: A Course in Electrical Machine Design, Dhanpat Rai & Sons.	1984
2	B. Edikins: Generalized Theory of Electrical Machines.	1995

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Fitzgerald: Electrical Machinery, Kingsley.	2002
2	M. G. Say: The Performance and Design of AC Machines, Pitman & Sons.	1958
3	R. K. Agrawal: Electrical Machine Design	2009

7EE6.3A: ECONOMIC OPERATION OF POWER SYSTEMS

B. Tech. (Electrical) 7th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Economics of Power Generation: Introduction, cost of electrical energy, expression for cost of electrical energy, depreciation, power plant cost analysis, economics in plant selection,	4
	selection of types of generation and types of equipments, factors effecting economic generations and distributions, generating cost, economics of different types of generating plants	4
2	Economical Operations of Thermal Power Plants: Methods of loading turbo generators, input, output and heat rate characteristics, incremental cost, two generations units,	4
	large no of units, sequence of adding units, effects of transmission losses, economic scheduling considering transmission losses, coordination equations, penalty factors	4
3	Hydro Thermal coordination: Advantages of combined operation, base load peak load operation requirement, combined working of run-off river and steam plant	4
	Reservoirs hydroplants and thermal plants (long term operational aspects), short term hydro thermal coordination, coordination equations, scheduling methods and applications.	4
4	Parallel Operations of Generators: Conditions, synchronizing current and power, two alternators in parallel (effect of change in excitation, load sharing, sharing of load currents),	4
	Infinite bus bars, active and reactive power control, synchronizing power, torque, operating limits of alternators, operating characteristics of cylindrical alternator rotor.	4
5	Economics for Electrical Engineers: Concepts of physical and financial efficiencies of electrical goods and services, supply and demand, break even and minimum cost analysis, linear and nonlinear break even, min cist analysis	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	J. Wood & B. F. Wollenburg: Power Generation, Operation and Control, John Wiley.	2013
2	D. P. Kothari & I. J. Nagrath: Modern Power System Analysis, MGH.	2003

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	O. I. Elgerd: Electric Energy System Theory, MGH.	1983
2	P. Kundur: Power System Stability and Control, MGH.	1994
3	Arthur R. Bergen and Vijay Vittal: Power System Analysis, Second Edition. PHI.	1999
4	C. L. Wadhwa: Electrical Power Systems, Newage International (P) Ltd.	2000
5	C. Gross, Power Systems Analysis, 2nd Edition. John Wiley & Sons.	1986

7EE7A: POWER SYSTEM PLANNING LAB (Common for EE and EX)

1. Status of National and Regional Planning, for power system
2. Write components of Structure of power system
3. Explain in detail various planning tools.
4. Write short note on Electricity Regulation
5. Modeling of Electrical Forecasting techniques
6. Transmission and distribution planning
7. concept of Rational tariffs
8. Rural Electrification

7EE8A: POWER SYSTEM MODELLING AND SIMULATION LAB (Common for EE and EX)

1. Simulate Swing Equation in Simulink (MATLAB)
2. Modeling of Synchronous Machine.
3. Modeling of Induction Machine.
4. Simulate simple circuits using Circuit Maker.
5. (a) Modeling of Synchronous Machine with PSS (b) Simulation of Synchronous Machine with FACTS device.
6. (a) Modeling of Synchronous Machine with FACTS device (b) Simulation of Synchronous Machine with FACTS devices.
7. FACTS Controller designs with FACT devices for SMIB system.

7EE9A: INDUSTRIAL ECONOMICS & MANAGEMENT (Common for EE and EX)

UNIT	CONTENTS
1	Money Banking and Trade: Functions of money, supply & demand for money, money price level & inflation, black money, meaning, magnitude & consequences. Functions of Commercial banks, banking system in India, shortcomings and improvements. Function of RBI, monetary policy-making, objectives and features. Sources of public revenue, principles of taxation, direct and indirect taxes, Theory of international trade, balance of trade and payment, Foreign exchange control, devaluation New economic policy: Liberalization, extending privatization, globalization.
2	Management Principles: Management functions, responsibilities of management to society, development of management thought. Nature of planning, decision making, management by objectives, Line and staff authority relationships, decentralization and delegation of authority, span of management.
3	Production Management: Production planning and control, inventory control, quality control and Total quality management. ISO standards Related to quality/Environment/safety etc. Tools of Project Management: CPM, PERT, project information systems. Marketing functions, management of sales and advertising marketing research.
4	Human Resource Management: Function, application of industrial psychology for selection, training and recruitment. Communication process, media channels and barriers to effective communication, theories of motivation, leadership.
5	Finance and Account Management: Engineering Economics: Investment decision, present worth, annual worth and rate of return methods. Payback time. Need for good cost accounting system, cost control techniques of financial control, financial statements, financial ratios, breakeven analysis, budgeting and budgetary control.

Syllabus B.Tech. (Electrical Engineering), 8th semester

SEE1A: EHV AC/DC TRANSMISSION (Common for EE and EX)

B. Tech. (Electrical) 8th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	EHV AC Transmission: Need of EHV transmission lines, power handling capacity and surge impedance loading. Problems of EHV transmission,	4
	Bundled Conductors: geometric mean radius of bundle, properties of bundle conductors. Electrostatic fields of EHV lines and their effects, corona effects: Corona loss, audio and radio noise.	4
2	Load Frequency Control: Introduction to control of active and reactive power flow, turbine speed governing system. Speed governing characteristic of generating unit and load sharing between parallel operating generators	4
	Method of Load Frequency Control: Flat frequency, flat tie line and tie line load bias control. Automatic generation control (description of block diagram only).	4
3	Voltage Control: No load receiving end voltage and reactive power generation. Methods of voltage control. Synchronous phase modifier	4
	Shunt capacitors and reactors, saturable reactors, Thyristorised static VAR compensators- TCR, FC-TCR and TSC- TCR.	4
4	FACTS: Introduction to FACTS controllers, types of FACTS controllers, Brief description of STATCOM, Thyristor controlled series capacitors and unified power flow controller.	8
5	HVDC Transmission: Types of D.C. links, advantages and disadvantages of HVDC transmission. Basic scheme and equipment of converter station. Ground return.	4
	Basic principles of DC link control and basic converter control characteristics. Application of HVDC transmission.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	E. W. Kimbark: Direct Current Transmission, Vol. 1, Wiley Interscience.	1971
2	K. R. Padiyar: HVDC Power Transmission System, Wiley Eastern Ltd.	1990

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	K. R. Padiyar: HVDC Power Transmission Systems. NEW AGE PUB	1992
2	J. Arrillaga: H.V.D.C Transmission, Peter Peregrines.	1983
3	J. Arrillaga HVDC et. al, : Computer Modelling of Electrical Power System. John Wiley.	1993

8EE2A: ELECTRIC DRIVES AND THEIR CONTROL (Common for EE and EX)**B. Tech. (Electrical) 8th Semester**
3L+1T**Max. Marks: 80**
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Dynamics of Electric Drives: Fundamental torque equations, speed-torque conventions and multi-quadrant operation,	4
	Nature and classification of load torques, steady state stability, load equalization, close loop configurations of drives.	4
2	DC Drives: Speed torque curves, torque and power limitation in armature voltage and field control,	4
	Starting, Braking: Regenerative Braking, dynamic braking and plugging. Speed Control-Controlled Rectifier fed DC drives, Chopper Controlled DC drives.	4
3	Induction Motor Drives-I: Starting, Braking-Regenerative braking, plugging and dynamic braking.	4
	Speed Control: Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control.	4
4	Induction Motor Drives-II: Variable frequency control from current source, Current Source Inverter (CSI) Control,	4
	Cycloconverter Control, Static rotor resistance control, Slip Power Recovery- Stator Scherbius drive, Static Kramer drive.	4
5	Synchronous Motor Drive: Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives.	4
	Dynamic and Regenerative Braking of Synchronous Motor with VSI. Control of Synchronous Motor Using Current Source Inverter (CSI).	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	G. K. Dubey: Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi.	2002
2	B. K. Bose: Power Electronics and Motor Drives, Elsevier.	2010

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	V. Subrahmanyam: Electric Drives- Concepts and Applications, MGH.	2011
2	Theodore Wildi: Electrical Machines, Drives and Power Systems, Pearson	2007
3	S. K. Pillai: A First Course on Electrical Drives, Wiley Eastern limited, India.	1989
4	N. K. De and Prashant K. Sen: Electric Drives, Prentice Hall of India Ltd.	1999

8EE3A: PROTECTION OF POWER SYSTEM (Common for EE and EX)**B. Tech. (Electrical) 8th Semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Causes and consequences of dangerous currents: Faults, overloads and switching over currents. Introduction to protection, trip circuit of a circuit breaker. Functional characteristics of a relay, zone of protection, primary and backup protection.	4
	CTs & PTs: Current transformer construction, measurement and protective CTs. Type of potential transformers. Steady state ratio and phase angle errors in CTs and PTs. Transient errors in CT and CVT (Capacitive Voltage Transformer).	4
2	Overcurrent Protection: HRC fuse and thermal relay. Overcurrent relays – instantaneous, definite time, inverse time and inverse definite minimum time overcurrent relays, time and current gradings.	4
	Induction disc type relay. Directional overcurrent relay, 30 ⁰ , 60 ⁰ and 90 ⁰ connections. Earth fault relay. Brief description of overcurrent protective schemes for a feeder, parallel feeders and ring mains.	4
3	Generator Protection: Stator protection–differential and percentage differential protection, protection against stator inter-turn faults, stator overheating protection.	4
	Rotor protection-protection against excitation and prime mover failure, field earth fault and unbalanced stator currents (negative sequence current protection).	4
4	Transformer Protection: Percentage differential protection, magnetizing inrush current, percentage differential relay with harmonic restraint. Buchholz relay. Differential protection of generator transfer unit.	4
	Busbar Protection: Differential protection of busbars. High impedance relay scheme, frame leakage protection	4
5	Transmission Line Protection: Introduction to distance protection. Construction, operating principle and characteristics of an electromagnetic impedance relay. Effect of arc resistance. Induction cup type reactance and mho relays. Comparison between impedance, reactance and mho relays. Three stepped distance protection of transmission line.	4
	Induction Motor Protection: Introduction to various faults and abnormal operating conditions, unbalance supply voltage and single phasing. Introduction to protection of induction motors- HRC fuse and overcurrent, percentage differential, earth fault and negative sequence voltage relays	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Badri Ram: Power System Protection and Switchgear, MGH.	2011
2	Ravindra Nath M. Chander: Power System Protection and Switch Gear, John Wiley Eastern.	1977

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Sunil S. Rao.: Power System Protection and Switch Gear, Khanna Publishers.	1999
2	Oza: Power System Protection and Switchgear, MGH.	2010

3	T. S. Madhava Rao: Power System Protections (Static Relays), MGH.	1989
4	A. R. Van C Warrington: Protective Relays, Chapman and Hall London.	1968
5	S. K. Basu and S. Chaudhary: Power System Protection, Raju Primlan Oxford.	1983

8EE4.1A: UTILIZATION OF ELECTRICAL POWER (Common for EE and EX)

B. Tech. (Electrical) 8th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Electric Heating: Different methods of electric heating. Principle of high frequency induction and dielectric heating. Construction, operation, performance and applications of arc furnace and induction furnace	4
	Electric Welding: Welding process, welding transformer, Classification of Electric Welding: arc welding, resistance welding, welding of various metals.	4
2	Illuminations: Definitions, laws of illuminations, polar curves, luminous efficiency, photometer, incandescent lamps, filament materials,	4
	Halogen lamp, electric discharge lamps, sodium vapour lamp, mercury vapour lamp and fluorescent lamp. Light Calculations: commercial, industrial, street and flood lighting.	4
3	Electrolytic Process: Principles and applications of electrolysis, electro-deposition, Manufactures of chemicals, anodizing, electro-polishing, electro-cleaning, electroextraction, electro-refining, electro-stripping (parting) power supplies for electrolytic process.	4
4	Electric Traction & Means of Supplying Power: Systems of Electric Traction: DC & AC Systems, Power Supply for Electric Traction System: Comparison and application of different systems. Sub-station equipment and layout, conductor rail & pantograph.	4
5	Traction Methods: Types of services, speed time and speed distance curves, estimation of power and energy requirements, Mechanics of train movement.	4
	Co-efficient of adhesion, Adhesive weight, effective weight. Traction Motor Controls: DC and AC traction motors, Series parallel starting. Methods of electric braking of traction motors.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	C. L. Wadhwa: Utilization of Electric Traction Electric Power.	1989
2	H. Partab: Art and Science of Electrical Energy, Dhanpat Rai & Sons.	1975

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	H. Partab: Modern Electric Traction, Dhanpat Rai & Sons	1973

8EE4.2A: FACTS DEVICES & THEIR APPLICATIONS

B. Tech. (Electrical) 8th Semester
3L+1T

Max. Marks: 80
Exam Hours: 3

UNIT	CONTENTS	CONTACT HOURS
1	Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability,	4
	Stability consideration. Power flow control of an ac transmission line. Basic types of facts controllers. Advantages of FACTS technology.	4
2	Voltage-Sourced Converters: Basic concept of voltage-sourced converters, single and three phase bridge converters. Introduction to power factor control. Transformer connections for 12-pulse, 24 pulse and 48 pulse operations.	4
	Static Shunt Compensators: Mid-point and end point voltage regulation of transmission line, and stability improvement. Basic operating principle of Static Synchronous Compensators (STATCOM). Comparison between STATCOM and SVC.	4
3	Static Series Compensators: Concept of series capacitive compensation, voltage and transient stabilities, power oscillation and sub synchronous oscillation damping.	4
	Introduction to thyristors switched series capacitor (TSSC), thyristor controlled series capacitor (TCSC), and static synchronous series compensator, - operation, characteristics and applications.	4
4	Static Voltage and Phase Angle Regulators: Voltage and phase angle regulation. Power flow control and improvement of stability by phase angle regulator.	4
	Introduction to thyristor controlled voltage and phase angle regulators (TCVR and TCPAR) (ii) Introduction to thyristor controlled braking resistor and thyristor controlled voltage limiter.	4
5	UPFC: Unified Power Flow Controller (UPFC), basic operating principles, conventional transmission control capabilities. Comparison of UPFC to series compensators and phase angle regulator. Applications of UPFC.	4
	IPFC: Interline Power Flow Controller (IPFC), basic operating principles and characteristics. Applications of IPFC.	4

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	K. R. Padiyar: Flexible AC Transmission Systems	2009
2	N. G. Hingorani, L. Gyugyi: Understanding FACTS: IEEE Press Book.	2000

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	Yong Hua Song, Allan T Johns : Flexible AC Transmission Systems FACTS	1999
2	Xiao Ping Zhang, Christian Rehtanz, Bikash Pal: Flexible AC Transmission Systems.	2006
3	R. Mohan & R. M. Mathur: Thyristor-based FACTS Controllers for Electrical Transmission Systems, John Wiley	2002

8EE4.3A: POWER SYSTEM TRANSIENTS**B. Tech. (Electrical) 8th Semester
3L+1T****Max. Marks: 80
Exam Hours: 3**

UNIT	CONTENTS	CONTACT HOURS
1	Wave terminology, Development of wave quotations, Terminal problems, Lattice diagrams,	4
	Origin and Nature of power system transients and surges, Surge parameters of plants, Equivalent Circuit representations. Lumped and distributed circuit transients.	4
2	Line energisation and de-energisation transients-Earth and earthwire effects. Current chopping in circuit breakers.	4
	Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short line fault studies.	4
3	Control of transients, Lightning phenomenon, influence of tower footing resistance and earth resistance,	4
	Traveling waves in distributed parameters multiconductor lines, parameters as a function of frequency.	4
4	Mechanism of Lightning Discharge Types of Lightning strokes, Harmful effects of lightning, protections against lightning, overhead Ground wires.	8
5	Lightening Arresters, Types of lightening arresters, Surge Absorber simulation of surge diverters in transient analysis. Fourier integral and z transform methods in power system transient	8

Text Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	C. S. Indulkar and D. P. Kothari: Power System Transients, NEW AGE.	2010
2	Lou Van der Sluis: Transients in Power Systems, John Wiley	2001

Reference Books

S. No.	Name of authors'/books/publisher	Year of pub.
1	N. R. Watson, J. Arrillaga: Power Systems Electromagnetic Transients, John Wiley	2001

8EE5A: COMPUTER BASED POWER SYSTEM LAB (Common for EE and EX)

1. Fault analysis (for 3 to 6 bus) and verify the results using MATLAB or any available software for the cases: (i) LG Fault (ii) LLG Fault (iii) LL Fault and (iv) 3-Phase Fault
2. Load flow analysis for a given system (for 3 to 6 bus) using (i) Gauss Seidal (ii) Newton Raphson (iii) Fast Decoupled Method and verify results using MATLAB or any available software
3. Study of voltage security analysis
4. Study of overload security analysis and obtain results for the given problem using MATLAB or any software.
5. Study of economic load dispatch problem with different methods.
6. Study of transient stability analysis using MATLAB/ETAP Software.

8EE6A: ELECTRICAL DRIVES AND CONTROL LAB (Common for EE and EX)

1. Study and test the firing circuit of three phase half controlled bridge converter.
2. Study and obtain waveforms of 3 phase half controlled bridge converter with R and RL loads.
3. Study and test the firing circuit of 3-phase full controlled bridge converter.
4. Study and obtain waveforms of 3-phase full controlled bridge converter with R and RL loads.
5. Study and test 3-phase AC voltage regulator.
6. Control speed of dc motor using 3-phase half controlled bridge converter. Plot armature voltage versus speed characteristic.
7. Control speed of dc motor using 3-phase full controlled bridge converter. Plot armature voltage versus speed characteristic.
8. Control speed of a 3-phase induction motor in variable stator voltage mode using 3-phase AC voltage regulator.
9. Control speed of a 3-phase BLDC motor.
10. Control speed of a 3-phase PMSM motor using frequency and voltage control
11. Control speed of universal motor using AC voltage regulator.
12. Study 3-phase dual converter.
13. Study speed control of dc motor using 3-phase dual converter.
14. Study three-phase cycloconverter and speed control of synchronous motor using cycloconverter.
15. Control of 3-Phase Induction Motor in variable frequency V/f constant mode using 3-phase inverter

8EE7A: HIGH VOLTAGE ENGINEERING LAB

1. Study filtration and Treatment of transformer oil.
2. Determine dielectric strength of transformer oil.
3. Determine capacitance and dielectric loss of an insulating material using Schering bridge.
4. Study solid dielectrics used in power apparatus.
5. Study applications of insulating materials.
6. Study direct testing and indirect testing of circuit breakers.
7. Study high voltage testing of electrical equipment: line insulator, cable, bushing, power capacitor, and power transformer.
8. Design an EHV transmission line.