NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

DEPARTMENT OF ELECTRICAL ENGINEERING

SYLLABII FOR UG 1st, 2nd, 3rd, 4th, 5th, 6th, 7th & 8th SEMESTERS

		HOUR			CREDIT			
1st Semester		Lecture	Tutorial	Practical	Lecture	Tutorial	Practical	Total
1	Language (Communication in English)	3	0	0	3	0	0	3
2	Engineering Chemistry-I	3	0	2	3	0	2	5
3	Engineering Physics-I	3	0	2	3	0	2	5
4	Engineering Mathematics-I	3	1	0	3	1	0	4
5	Engineering Mechanics I	3	1	0	3	1	0	4
6	Basic Electrical Engineering	3	1	2	3	1	2	6
6	Engineering Graphics-I	0	0	3	0	0	3	3
7	Workshop Practice-I	0	0	2	0	0	2	2
								32
2nd Semester								
1	Introduction to programming	3	1	2	3	1	2	6
2	Engineering Physics-II	3	0	0	3	0	0	3
3	Disaster management	2	0	0	2	0	0	2
4	Engineering Mathematics-II	3	1	0	3	1	0	4
5	Engineering Chemistry-II	2	0	0	2	0	0	2
6	Engineering Mechanics –II	3	1	0	3	1	0	4
7	Basic Electronics	3	1	2	3	1	2	6
8	Engineering Graphics-II	0	0	3	0	0	3	3
9	Workshop Practice-II	0	0	3	0	0	3	3
								33
3rd Semester								
1	Mathematics III	3	1	0	3	1	0	4
2	Energy Conversion system I	3	1	0	3	1	0	4
3	Network Analysis	3	1	2	3	1	1	5
4	Digital Electronics	3	1	2	3	1	1	5
5	Object Oriented Programming	3	0	3	3	0	2	5
6	Solid state devices	3	0	0	3	0	0	3
7	Signal and Systems	3	0	3	3	0	2	5
								31
4th Semester								
1	Energy Conversion System II	3	1	3	3	1	2	6
2	Power System I	3	1	0	3	1	0	4
3	Electrical Measurement and Measuring Instruments	3	1	2	3	1	1	5
3	Numerical Methods and Analysis	3	1	2	3	1	1	5
5	Analog Electronics	3	1	2	3	1	1	5
6	Elective I	3	0	0	3	0	0	3
								28
5th Semester								
1	Energy Conversion System III	3	1	3	3	1	2	6
2	Power System II	3	1	3	3	1	2	6
3	Microprocessors and Micro controller	2	0	4	2	0	2	4
4	Control System I	3	1	2	3	1	1	5
5	Electromagnetic Field Theory	3	1	0	3	1	0	4
								25
6th semester								
1	Power Electronics	3	1	3	3	1	2	6
2	Control System II	3	1	2	3	1	1	5
3	Digital Signal Processing	3	0	2	3	0	1	4
4	Industrial Instrumentation	3	1	2	3	1	2	6
5	Principle of Communication	3	0	2	3	0	1	4
6	Industrial Visit/ internship							**audit**

								25
7th Semester								
1	Engineering Economics	3	0	0	3	0	0	3
2	Electrical Drives	3	0	3	3	0	2	5
3	High Voltage Engineering	3	0	2	3	0	1	4
4	Elective II	3	1/0	0/2	3	1/0	0/1	4
5	Elective III	3	1/0	0/2	3	1/0	0/1	4
6	Project –I	0	0	6	0	0	4	4
								24
8th semester								
1	Industrial Management	3	0	0	3	0	0	3
2	Electrical Machine Design	3	0	2	3	0	1	4
3	Elective IV	3	1/0	0/2	3	1/0	0/1	4
4	Elective V	3	1/0	0/2	3	1/0	0/1	4
5	Grand Viva				0	0	4	4
6	Project –II	0	0	6	0	0	6	6
								25
TOTAL								**223**

1st Semester

1. Language (Communication in Engish)

Pronunciation, Vocabulary Extension, basic aspects of language skills, modes of writing, comprehension, composition, word-order.,structure of words etc.
The fundamentals of Grammar, textual pieces for literary appreciation, non-traditional materials, newspaper articles, advertisements, notice writing, Soft Skills Development etc. The following textual pieces from "English for All" by Nilanjana Gupta, published by Mac Millan :

Text/Reference Books :-

1. Shakespeare's Sister by Virginia Woolf
2. Scientific Research for Amateurs by J.B.S. Haldane
3. When I Have Seen by William Shakespeare
4. Lines Written in Early Spring by William Wordsworth
5. On His Blindness by John Milton
6. Prospice by Robert Browning
7. After Twenty Years by O' Henry
8. The Adventures of the Blue Carbuncle by Arthur Conan Doyle

2. Engineering Chemistry I

a) Chemical Bonding:-

Ionic and Covalent bonds; Valence Bond Theory (V.B.T) of covalency- atomic orbital.and their overlap, hybridization of orbitalsdefinition types and associated geometries, VSEPR theory, shapes of simple molecules like-H2O, CO2, NH3, CH4,C2H6, C2H2 BF3, PCl5, SF6 in the light of the hybridization state of the central atom and VSEPR effects; Molecular Orbital Theory (M.O.T)- concept of molecular orbital, molecular orbital energy level diagrams of homonuclear diatomic molecules-He2,O2, N2 and molecular ions, determination of bond order, bond length and magnetic properties from M.O diagrams; Noncovalent
interactions- van der Waals and hydrogen bonding and their effect over physical properties of different substances,metallic bonds-Electron sea model.

b) Fuels:-

Definition and classification of fuels; Characteristics of a good fuel, comparison between solid, liquid and gaseous fuel; Calorific value of fuels- definition, units, higher and lower calorific value, determination of the calorific value of a solid fuel by bomb calorimeter; Solid fuel- coal, origin, types, proximate and ultimate analysis of coal; Liquid fuel- petroleum, origin, refining of crude, cracking, synthetic petrol, Fischer-Tropsch and Bergius method for the synthesis of gasoline,knocking

c) Water:-

Introduction; Hardness of Water- cause, types, units, disadvantages of using hard water fordomestic and industrial purposes (e.g., scale and sludge formation in boilers, causticembitterment, boiler corrosion etc.), softening of hard water (lime-soda, permutit and ionexchangeprocesses); Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness and dissolved oxygen, numerical based on determination of hardness.

d) Pollution and its control:-

Pollution- introduction, air pollutants, particulates, smog, photochemical smog, acid rain, green house effects, depletion of ozone layer, analysis of gaseous effluents-oxides of nitrogen, oxides of sulphur and H2S, control of air pollution- particulate emission, gaseous pollutants, water pollution- arsenic pollution and its remedies. Chemical analysis of effluent liquid streams, BOD, COD.

e) Electrochemistry:-

Arrhenius theory of electrolytic dissociation, classification of electrolytes; degree of dissociation of acids, dissociation constant of weak acids, Debye-Huckel theory, concept of pH and pOH, buffer solutions, solubility product, common ion effect, conductance of solutions- specific, molar and equivalent conductance, variation of molar conductance with dilution for strong and weak

electrolytes; Migration of ions- Kohlrausch's law of independent migration of ions, Ostwald's dilution law; transport number, Nernstequation for single electrode, electrochemical cells.

f) Polymer Chemistry**:-**

Introduction, types of polymerization, classification of polymers based on chaincharacteristics, source, method of synthesis and molecular forces involved, mechanism ofpolymerization reaction: cationic, anionic and catalytic polymerization; glass transition andcrystalline melting point temperatures, Factors influencing glass transition and crystalline melting point temperatures. Preparation, properties and uses of the following-Polyethylene, PVC, Polystyrene, PAN, Teflon, Nylon- 6:6, polyester ; Rubber- monomer,structure, compounding of rubber, vulcanization, synthetic rubbers- Buna-S, Buna-N, neoprene, butyl rubber and polyurethanes.

ENGINEERING CHEMISTRY I LABORATORY:

List of experiments:

1. Determinations of hardness of water.
2. Determinations of percentage purity of lime stone sample.
3. Determinations of dissolved oxygen in water.
4. Determinations of sodium carbonate & sodium bicarbonate in a mixture.
5. Determinations of iron content in a sample.
6. Determinations of chloride content of water.
7. Determinations of proximate analysis of coal.
8. Determinations of flash point of an oil by penskymartein's closed cup flash point Apparatus.
9. Determinations of viscosity of oil by redwood viscometer.
10. Determination of Dissociation constant of weak acids by conductometric Titration.
11. Determinations of carbon residue of oil by Conrad son's apparatus.
12. Determination of pH of an electrolyte by potentiometer Titration.

Text/Reference books:

1. Jain & Jain , Engineering Chemistry; 15th Edition,
2. Engineering Chemistry; Wiley - India.
3. S.S Dara, S chand Publisher , A Text Book of Engineering Practical Chemistry .
4. Sashi Chawla, A text book of Engineering Chemistry;
5. S.S Dara, S chand Publisher, A Text Book of Engineering Chemistry;
6. A.K Dey, Environmental Chemistry, John Wiley.
7. Ashim K das , Environmental chemistry with Green chemistry, Books and Allied Pvy. Ltd.
8. Vanloon/Duffy, Environmental Chemistry ,2/E, Oxford University Press.
9. O. G. Palanna, Engineering Chemistry, Tata Mc.Graw Hill Education Private Ltd. New Delhi.

3. Engineering Physics I

1. Vector and Vector Differential Calculus:

Types of Vectors, Orthogonal Representation of a Vector, Product of Vectors, Scalar TripleProduct, Vector Triple Product. Vector Differentiation, Scalar and Vector Fields,Directional Derivatives, Vector Differential Operator, Gradient, Divergence, Curl, Line, Surface & Volume integrals and their applications, Green's theorem.

2. Mechanics:

Newton's Laws of motion, Mechanics of a Particle, Limitations of Newtonian mechanics,Newton's laws of motion for a system of particles, Constraints, D'Alembert's Principle,Generalized Coordinates, Generalized velocity and momentum, Lagrangian formulation,Hamiltonian formulation. Streamline and turbulent motion, Stokes law,terminal velocity, Poiseuille's Equation, Bernouli's theorem, Venturimeter and otherapplications of Bernouli's principle. Reference frames, Lorentz transformation,postulates of relativity, relativistic mass and mass-energy relation.

3. Vibration and Waves:

Simple Harmonic Motion, superposition of two linear SHMs, Lissajous figures,Damped Vibration:- differential equation and solution, critical damping, logarithmicdecrement, analogy with electrical circuit. Progressive waves, Forced Vibration,Amplitude and Velocity Resonance, Sharpness of resonance and quality factor.

4. Time Varying Field and Maxwell's Equation:

Laws of Electromagnetic Induction, Self and Mutual induction, Concept of DisplacementCurrent, Difference between Conduction Current and Displacement Current, EddyCurrent, Maxwell's Equations, Derivation of Maxwell's Equations, Propagation of Electromagnetic Waves in free space/ dielectrics/conductors, Solution ofpropagation of Plane Electromagnetic Wave in free space/dielectrics/conductors.

5. Optics: Interference, Diffraction, Polarization

Interference: Coherence (temporal and spatial), Interference of Light due to division of wave front (Young's double slit and Fresnel's Bi-prism), Interference of Light due to division of amplitude (Newton's Ring), colour of thin film.

Diffraction: Different Types of Diffraction, Difference between Interference andDiffraction, Fraunhofer Diffraction at a Single Slit and Double slit, Plane transmission diffraction grating spectra, Comparison between Grating and Prism Spectra, Resolving Power of an optical instrument and limit of resolution.

Polarization: Plane of Vibration and Plane of Polarization, Classification of Polarized Light.

ENGINEERING PHYSICS-I LAB

Laboratory experiment based on syllabus of Physics - I

Text/Reference Books :-

1. H. K. Dass, Mathematical Physics.
2. Rana & Joag, Classical Mechanics, Tata McGraw- Hill Education, India.
3. D.S. Mathur, Elements of Properties of Matter,S. Chand publication
4. Dattu Prasad Joshi, Engineering Physics, Tata Mc Graw Hill
5. D. J. Griffith, Introduction to Electrodynamics, Pearson
6. Brijlal & Subramaniyam, A Text Book of Optics, S.Chand Publication
7. Relativity, R. Resnick, Wiley Eastern Pvt. Ltd.
8. L.A. Pipes and L.R. Harvill, Applied Mathematics for Engineers and Physicists, McGraw-Hill
9. A. Ghatak, Optics, Tata Mc Graw Hill

4. Engineering Mathematics I

1. Infinite series: Convergence of Sequence, Bounded Sequence, Monotonic Sequence, Convergent, Divergent and Oscillatory Series, Geometric Series, Positive term series, p-series, Comparison Test, D'Alembert's Ratio tests, Raabe's Test, Gauss's Test, Cauchy's Integral Test, Cauchy's Root test, Logarithmic Test.

2. Calculus of function of one variable: Limit and continuity of functions, Uniform continuity and differentiability, successive differentiation, Leibnitz's theorem, Rolle's theorem, Mean Value theorems and Taylor's theorem, expansion of functions into Taylor's and Maclaurin's series, Indeterminate forms, Curvature, Asymptotes, Concavity, Convexity and point of inflexion.

3. Function of Several Variables: Limit, Continuity, Partial Derivatives, Chain Rule, Differentiation of Implicit functions, Exact Differentials, Euler's theorem on homogeneous function and its converse, Tangent planes and Normal planes, Maxima, Minima and Saddle points, Simple problems in extrema of functions with constraints, Method of Lagrangian Multipliers.

4. Ordinary Differential Equation: First order ordinary differential equation, Linear equations and Bernoulli's equation, Ordinary linear differential equation of nth order, Solution of homogeneous and nonhomogeneous equations, Operator method, method of undetermined coefficients and variation of parameters, Solution of simple simultaneous ordinary differential equation. Series solution of differential equation.

5. Laplace Transform: Transforms of elementary functions, Inverse transforms, properties of laplace transform, Convolutions, Transforms of periodic functions, unit step functions, shifting theorems, Solution of ODE's using transforms.

Text/Reference Books :-

1. M.D. Raisinghania. Ordinary Differential Equation
2. Malik & Arora. Mathematical Analysis
3. H.K. Dass, Advanced Engineering Mathematics
4. B.V.Ramana, Higher Engg. Mathematics
5. E. Kreyszig, Advanced Engineering Mathematics

5. Engineering Mechanics I

Force Systems and Equilibrium

Force moment and couple, principle of transmissibility, Varignon's theorem. Resultant of force system- concurrent and nonconcurrent coplanar forces, free body diagram, equilibrium equations and their uses in solving elementary engineering problems.

Plane trusses

Analysis of plane trusses and plane frames (Analytical and graphical methods). Method of joints, methods of sections, graphical method.

Friction

Coulumb's laws of fraction, belt fraction problems involving fraction related to practical application.

Moment of Inertia and plane figure:-

Moment of Inertia of a plane figure with respect to an axis in its plane, Moment of Inertia with respect to an axis perpendicular to the plane of the figure. Parallel axis theorem, perpendicular axis theorem. Polar moment of inertia

Moment of inertia of material bodies:

Mass moment of inertia in case of disc cone cylinder sphere slender rod

Centre of gravity of rigid body

Centre of gravity of right circular cone, cylinder,hemisphere and composite rigid body.

Virtual work :

Work of a force principle of virtual work & itsapplication, Constriction of force polygon, Raydiagram, Funicular polygon, Maxwelldiagrams. Mass moment of inertia in case of disc, cone,cylinder, sphere slender rod.

ENGINEERING MECHANICS LAB

Syllabus based on Engineering Mechanics.

Text/Reference Books:

1. Timoshenko and Young, *Engineering Mechanics.*
2. R.S. Khurmi , *A text Book of Engineering Mechanics*.
3. R.K. Bansal , *A text Book of Engineering Mechanics.*

6. Basic Electrical Engineering

Classification of devices of an electrical circuit; Basic devices: resistors, controlled sources, diodes, capacitors and inductors.

Basic circuit analysis methods: nodal, mesh and modified nodal-analysis.

Network Theorems: Tellegen's theorem, superposition theorem, Thevenin-Norton theorem, substitution theorem, reciprocity theorem, maxpower-transfer theorem, stardelta- transformation.

Steady state sinusoidal analysis: phasors, phasor diagrams; Power in ac circuits, network analysis methods; Polyphase circuits.

Electromagnetism---- Concept of inductance,, Magnetisation curve, Hysteresis loop and hysteresis loss, Eddy-current loss, mutual inductance, dot convention

Classification of analog electrical measuring instruments working principles of indicating type of instruments.

Electromagnetic laws, Basic principle of generator and motor, emf induced in a coil, concept of rotating magnetic field. Introduction to transformer.

BASIC ELECTRICAL ENGINEERING LABORATORY

List of experiments

1) Calibration of energy meter
2) Characteristics of Fluorescent Lamp, Incandescent Lamp.
3) Determination of fusing constant of a fuse wire.
4) Determination of insulation resistance by using Megger.
5) Measurement of 1 –phase & 3 -Phase paired by watt meters.
6) Characteristics of R-L Circuit, R-C ckt, R-L-C series ckt.

7) Study of different transformer connections.

Text/Reference Books:

1. K.V.V. Murthy and M.S.Kamath, Basic Circuit Analysis, 1st edition (reprinted with corrections) Jaico publishing, 1998.
2. W.H. Hayt and J.E. Kemmerley, Engineering Circuit Analysis, Int.St.Ed.(4th) McGraw Hill, 1986.
3. S.K.Bhattacharya, 'Electrical Machines', Tata McGraw Hill Publishing company ltd,. second edition, 2007
4. J. Nagrath and D. P. Kothari, 'Electric Machines', Tata McGraw Hill, 1985.

7. Engineering Graphics I

Drawing instruments and their uses, lines, lettering and dimensioning, scales, plains and diagonal scale, curves used in engineering practice, ellipse, parabola, hyperbola, cycloid, involutes orthographic projection, planes of projection, four quadrant, first angle projection, reference line, convention employed. Projection of points and lines, true length, true inclinations with reference plane, traces of a line, end view, and illustrative problems. Projection of planes, traces, end view planes perpendicular to one inclined to other reference planes. Projections of solid such as prism, pyramid, cone, cylinder, cube etc.

Text/Reference Books:

1. N.D. Bhatt , *Elementary Engineering Drawing (Plane and solid geometry).*
2. R.B Gupta , *A text Book of Engineering Drawing*.
3. K.Venugopal , *A text Book of Engineering Drawing*.
4. N.D. Bhatt, *Machine Drawing.*
5. R. K. Dhawan , A text Book of Machine Drawing (In first angle projection)

8. Workshop Practice I

1. Fitting Shop
i) Introduction of hand Tools.
ii) Job No. 01:- Making of Square bar from round bar of mild steel by metal wearing process.
iii) Job No.02:- Making of V-Groove on Mild Steel Flat by metal cutting process.
2. Carpentry Shop
i) Introduction of Hand Tools.
ii) Job No.01:- Making of wooden End half lap joint.
iii) Job No.02:- Making of wooden T-Joint.
3. Smithy Shop
i) Introduction of Hand Tools
ii) Job No.01:- To make square bar from round bar of Mild Steel by heating& hammering.
iii) Job No.02:- To make Hexagonal bar from round bar of Mild Steel by heating & hammering.

2nd Semester

1. Introduction to Programming

BASIC OF COMPUTERS:
Computer fundamentals: Bits and Bytes , CPU, Memory, Input and output devices, I/O devices, operating system, Application software's , Number system- Decimal, Binary, Octal, Hexadecimal.Need for high level languages, Program design using flow charts
C LANGUAGE PRELIMINARIES:
C character set, Identifier and keywords, data types, declaration, expression, statements and symbolic constants.
Pre-processor commands: #include, #define, #ifdef
Input-Output: getchar, putchar, scanf, printf, gets,puts.
Operators and expressions: Arithmetic, unary,assignment, logical, conditional, and bit wise operators.
Control statements: if else, for, while, do-while, switch, break, continue, nested loops.
Storage types: Automatic, external, register andstatic variables.
Functions : Definiting and accessing , Passing arguments, Function prototypes, Recursion, Libraryfunctions, Static functions.
Arrays: Definiting and processing, Passing arrays to a function, Multi-dimension arrays.
Pointers: Basic concepts, malloc, pointer and arrays, simple single linked list example.

INTRODUCTION TO PROGRAMMING LABORATORY
Programming simple problems exercising different features of C

Text/Reference Books:

1. Introduction to Computer Science- ITL Education Solutions Limited , Pearson Education
2. *Paul Deitel* , C How to Program -5th Edition, PHI.
3. *Dennis Ritchie and Brian Kernighan*, The C Programming Language, PHI.
4. *Behrouz A. Forouzan, Richard F. Gilberg*, Computer Science: A Structured Programming Approach Using C , Course Technology
5. *Gottfried, Byron S*, Programming with C , TMH
6. *E. Balagurusamy*, C Programming By, TMH

2. Engineering Physics –II

1. Modern Physics:
Particle properties of wave: Planck's hypothesis, Photoelectric effect, Compton Effect. Wave properties of particle: De Broglie wave as mater waves, Davison-Germer experiment, Heisenberg's uncertainty principle and its application. Quantum Mechanics: Interpretation of wave function, Schrödinger equation (time dependent and time independent), particle in a box, Eigen values and Eigen function. Nuclear structure, atomic masses, mass spectrograph, particle accelerator (Betatron, Cyclotron, Synchrocyclotron), Nuclear reactors.
2. Solid State Physics and Nanotechnology:
Crystallography: Crystalline and amorphous solids, crystal structure, Bravais Lattice, Packing Fraction, Crystallographic planes and miller indices, Inter-planer spacing (cubic system only), Bragg's diffraction, Crystal structure analysis, Defects and disorders. Nanotechnology: Nanoscience: Nanomaterials and types: Quantum Dots, Quantum wires, Quantum wells, Nanocomposites, Properties.
3. Statistical Mechanics:
Concept of phase space, macro and micro states, ensembles, statistical distributions MB, B-E & F-D statistics (No derivations), Planck's law of radiation, Fermi energy, electron distribution in metal.
4. Plasma Physics
Definition of plasma & Collective behaviour, Concept of temperature, Quasineutrality & Debye shielding, Criteria for plasmas, Plasma Oscillations; Single particle motions in - uniform and

nonuniform electric and magnetic fields, time varying electric and magnetic fields,applications of plasma physics (Fusion, Industrial), Confinement of plasma (magneticand LASER).

5. Laser and Optical Fiber:

Spontaneous and stimulated emission, Einstein's A-B coefficient, meta-stable state, population inversion, basic principle of laser (three and four level), optical cavity and resonator, Ruby and He-Ne laser. Propagation of light in fiber, step and graded index fiber, numerical aperture, attenuation in optical fiber, introduction of optical window, application of laser and optical fiber.

Text/Reference Books:

1. Francis F. Chen , Plasma Physics and Controlled Fusion, Springer
2. A. Ghatak, K. Thyagrajan, Lasers: Fundamentals and Applications, Springer
3. K. Huang, Statistical Mechanics
4. D.C. Tayal, Nuclear Physics, Himalaya House, Bombay
5. Kittel, Introduction solid State Physics, Willy Eastern Limited
6. A.K.Ghatak and S.Lokanathan, Quantum Mechanics, Macmillan India Limited
7. Mark A. Ratner & Daniel Ratner, Nanotechnology: a gentle introduction to the next big idea, PHI
8. Dattu Prasad Joshi, Engineering Physics, Tata Mc Graw Hill
9. B.K. Agarwal, Elements of Statistical Mechanics
10. R. Eisberg and Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley India Pvt. Ltd.
11. Leonard I. Schiff, Quantum mechanics
12. Dekker, Solid State Physics, McMillan Student Ed.

3. Disaster Management

Elements of Engineering Seismology:- Earthquake occurrence in the world, causes of Earthquake, Plate tectonics, Earthquake mechanism, seismic zoning map of India and its use.

Earthquake phenomenon:- Focus, Epicenter, seismic waves, magnitude, intensity scale its co-relation assessment and Do's and Don's for protection of life and property during disaster.

Landslides:- Geo-technical aspects of landslides and control of Landslide Hazard.

Flood:- Flood control as a measure of Disaster Management and Mitigation

Cyclone and Fire:- Cyclone Disaster Mitigation and ensuring wind and fire hazard safety during disaster.

Text/Reference Books:

1. A.K.Mukhopadhay, Crisis and Disaster Management Turbulence and Aftermath, New Age International Publishers.
2. H.N.Srivastava, S.N. Bhattacharya. G.D.Gupta, Earthquake Geography and Management, New Age International Publishers.
3. Thomas D. Schneid, Larry Collins, Disaster Management and Preparedness, Lewis Publishers, 2001.
4. C. V. R. Murty, IITK-BMTPC Earthquake Tips: Learning Seismic Design and Construction, National Information Centre of Earthquake Engineering.

4. Engineering mathematics II

1. Matrices : Algebra of matrices, Vector spaceslinear dependence of vectors, basis, Linear Transformations, Rank and inverse of a matrix, Solution of algebraic equations, consistency conditions, Hermitian, skew-Hermitian and Unitary matrices, by-linear form, eigen value and eigen vectors. Cayley-Hamilton theorem.

2. Complex numbers : Exponential complex numbers and logarithm of a complex number, circular, hyperbolic and inverse circular functions of complex numbers.

3. Function of a Complex Variable : Limit, continuity and differentiation, Analytic function, Cauchy-Riemann equations, Conjugate functions, Application to two dimensional problems, Taylor's and Laurent's expansions, Branch points, zeros, poles, residues, Cauchy's Integral theorem, simple problems on Contour Integration.

4. Integral Calculus : Improper Integrals, Beta and Gamma function. Double and Triple Integrals, Jacobians and transformation of co-ordinates.

5. Vectors: Scalar and vector triple product, space curves, Seret-Frenet formula, velocity and acceleration-simple problems, moment of force, work done, angular velocity, relative velocity-imple applications. Vector function of one variable, vector differentiation and integration, gradient, divergence and curl ---Applications. Stoke's theorem, Green's theorem, Gauss divergence theorem - simple applications to areas, Volumes and centre of Pressure.

Text/Reference Books:

1. Malik & Arora, Mathematical Analysis:
2. H.K.Dass., Advanced Engineering Mathematics
3. B.V.Ramana. Higher Engg. Mathematics
4. E. Kreyszig , Advanced Engineering Mathematics.
5. G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry:
6. M.L.Khanna , Vector Calculas

5. Engineering Chemistry –II

(a) Cement:-

Introduction, classification; Portland Cement definition, raw materials, manufacture, ideal composition and physical requirement according to I.S code, chemical constitution of the finished product, setting and hardening, heat of hydration; Special Cements- high-alumina, white portland, water-proof cements etc.

(b) Refractories:-

Definition, objective of using, classification based on chemical nature; Properties- refractoriness, strength, dimensional stability, chemical inertness, thermal expansion, thermal conductivity, porosity, spalling, electrical conductivity etc. and interrelations between them; selection of good refractory; Common Refractory Bricks- silica, fireclay, high alumina, magnesite and zirconia bricks, properties and uses.

(c) Corrosion:-

Introduction, definition, classification; Dry Corrosion factors effecting dry corrosion, mechanism, types, oxidation corrosion, Pilling-Bedworth rule, corrosion by other gases, hydrogen related corrosion, liquid metal corrosion; Wet Corrosion- types, chemical corrosion, factors affecting chemical corrosion, mechanism of wet corrosion- electrochemical mechanism, evolution of H2 and absorption of O2 types; Differential aeration theory, passivity, pitting, waterline and stress corrosion; Corrosion Control purification, alloying, application of protective coatings, cathodic protection etc.

(d) Lubricants:-

Introduction; Mechanism- thick-film, thin-film and extreme pressure lubrication; Classification of Lubricants- lubricating oils, greases and solid lubricants, their properties, use and additives required (e.g., anti-oxidants, corrosion preventers etc.); Properties of Lubricating Oils- viscosity, flash and fire-point, cloud and pour point, oiliness, carbon residue, aniline point etc. ; Cutting fluids.

(e) Thermochemistry:-

Different types of energy and other definitions; Endothermic/ Exothermic Reactions and Energy Diagrams; thermochemistry stoichiometry, enthalpy, standard enthalpy of formation and reaction, Hess's Law, heat of solution, heat of neutralization.

Text/Reference Books:

1. Jain & Jain , Engineering Chemistry; 15th Edition,
2. Engineering Chemistry; Wiley - India.
3. S.S Dara, S chand Publisher , A Text Book of Engineering Practical Chemistry .
4. Sashi Chawla, A text book of Engineering Chemistry;
5. S.S Dara, S chand Publisher, A Text Book of Engineering Chemistry;
6. A.K Dey, Environmental Chemistry, John Wiley.
7. Ashim K das , Environmental chemistry with Green chemistry, Books and Allied Pvy. Ltd.
8. Vanloon/Duffy, Environmental Chemistry ,2/E, Oxford University Press.
9. O. G. Palanna, Engineering Chemistry, Tata Mc.Graw Hill Education Private Ltd. New Delhi.

6. Engineering Mechanics II

Kinematics of a particle - simple relative motion:
Introduction, general notions, differentiation of a vector with respect to time, velocity and acceleration calculations, rectangular components, velocity and acceleration in terms of path variables, cylindrical coordinates, simple kinematical relations and applications, simple relative motion, motion of a particle relative to a pair of translating axes.
Particle dynamics:
Introduction, rectangular coordinates, rectilinear translation, Newton's law for rectangular coordinates, rectilinear translation, cylindrical coordinates, Newton's law for cylindrical coordinates, path variables, Newton's law for path variables, a system of particles, the general motion of a system of particles.
Energy methods for particles
Analysis for a single particle, power considerations, conservative force field, conservation of mechanical energy, alternative form of work-energy equation, systems of particles, work-energy equations, kinetic energy expression based on centre of mass, work kinetic energy expressions based on centre of mass.
Methods of momentum for particles
Linear momentum, impulse and momentum relations for a particle, linear momentum considerations for a system of particles, impulsive forces, impact, moment of momentum, moment of momentum equation for a single particle and for a system of particles.
Kinematics of rigid bodies: Relative motion
Introduction, translation and rotation of rigid bodies, Chasles' theorem, derivative of a vector fixed in a moving reference, applications of the fixed-vector concept, general relationship between time derivatives of a vector for different references, the relationship between velocities of a particle for different references, acceleration of a particle for different references.
Kinetics of rigid bodies
Moment-of-momentum equations for general motion of rigid bodies, Euler equations, Plane motions, Pure rotation of a body of revolution about its axis of revolution, General plane motion concept of a slab like body, Pure rotation of an arbitrary rigid body.

Text/Reference Books :-

1. F.P. Beer and E.R. Johnston, Vector Mechanics for Engineers - Dynamics, McGraw Hill Book Company, 2003.
2. J. L. Meriam and L.G. Kraige, Engineering Mechanics - Dynamics, John Wiley & Sons, 2002.
3. H. Shames, Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice Hall of India, 1996.

7. Basic Electronics

Elementary Physics of Semiconductor Material.
PN Junction Diode- Operation Characteristics and Modelling, Zener Diode- Operation and Application; Diode Rectifiers, Filters, Clipper, Clamper.
BJT Operation and Characteristic, NPN & PNP transistor, BJT biasing, Different circuit configurations with Circuit Models.
Introduction to JFET Operation, Main Carriers in BJT & FET and Characteristics.
Operational Amplifiers- Inverting & Non inverting Configuration and its Common Applications
IC-555 Timer Circuit- Astable, Monostable & Bistable Operations.
Cathode Ray Oscilloscope. Elementary Construction, Connections for Viewing Signals, Measuring Voltage, Frequency and Time Period.
Elementary Physics of Opto electric Devices like LED,LCD Devices, Photo-Diode, Photo-Transistor, LDR,7-segment Display, Opto isolators.

BASIC ELECTRONICS LABORATORY

Selected experiments based on Basic Electronics.
1) Study of characteristics of transistor indifferent modes i.e. common a emitter, common base and common collector configuration.

2) Experiments on class-A, class-B and AB of transistor power amplifiers.
3) Experiment on uncontrolled Diode-Bridge rectifier.
4) Determination of hybrid parameters of a transistor.
5) Characteristics of JFET, MOSFET.
6) Study of characteristics of Mono-stable, Bistable and a-stable multi vibrators using bipolar transistors.
7) Experiment on Schmitt Trigger Circuit.
8) Study of LED, photo-Diodes, Photo-Transistors, Light Development Resistors and Opto-Isolators.

Text/Reference Books :-

1. Vladimir V.Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, Introduction to Nanoelectronics - Science, Nanotechnology,Engineering and Application, Cambridge University Press.
2. D. De and K. P. Ghatak , Basic Electronics, Pearson Education.
3. R.F. Pierret, Semiconductor Device Fundamentals, Pearson Education.
4. Robert F Pierret and Gerold W.Neudeck , Modular Services on Solid State Device, Addison Wesley Publishing Company
5. K. Sedra & Smith, Microelectronic Circuits , Oxford
6. D. Carlo & Lin , Linear Circuit Analysis, Oxford University Press

8. Engineering Graphics II

1) To draw sectional views, true shape of section of solid like Prism, Pyramid, cones cylinder with and without sections.
2) To draw views and Isometric projection of solids like Pyramid, Prism, cones, cylinder, sphere and hemisphere.
3) Development of surface prism, Pyramid, cones, cylinder with and without sections.
4) To draw sketch of bolts, nuts, rivets and riveted joints.
5) To draw plan, elevation, side view of machine parts with and without sections.

9. Workshop Practice II

1. Machine Shop
a) Introduction of operation of Machine Tools.
b) Job No. 01:- Facing and Turning operation by using Lathe machine.
c) Job No. 02:- Step turning operation by using Lathe machine.
2. Fitting Shop
Introduction of Precision Tools.
Job No. 01:- Making of an External Thread by using Die and Die Stock
Job No. 02:- Making of an Internal Thread by using Tap and Tap wrench.
3. Welding Shop
a) Introduction to Welding Machines and related Tools.
b) Job No.01:- Lap joining of two metal plates by arc welding process.
c) Job no.02:- Butt joining of two metal plates by arc welding process.
4. Forging Shop
a) Introduction of forging process and related tools.
b) Job No.01:- Making of mild steel ring by forging process.
c) Job NO.02:- Making of Square punch from round Mild Steel Bar.
5. Pattern Shop
a) Introduction of wood working Machine Tools.
b) Job No.01:- Making of wooden Knuckle Joint.
c) Job No.02:- Making of wooden Halving Joint.
6. Sheet Metal Shop
a) Introduction of machine tools & hand tools.
b) Job No. 01:- Metal sheet single seam joining.

c) Job No. 02:- Metal sheet joining by riveting.

7. Casting Shop

a) Introduction of Casting process & related tools.

b) Job No. 01:- metal casting using a pattern of Knuckle Joint.

8. Automobile Shop

a) Introduction of working principle of IC Engine.

b) Demonstrations of different parts of an IC engine

3rd Semester

1. Mathematics III

Probability and statistics-classical and axiomatic definition of probability, conditional probability, independent events, random variables, probability mass function and probability density function, distribution function, function of random variables, standard univariate discrete and continuous distribution and their properties, mathematical expectation, moments, moments generating function, correlation and regression. Function of several variables-partial derivatives, chain rule, differentiation of implicit functions, exact differentials, tangent planes and normal planes, maxima, minima and saddle points, simple problems in extrema of functions with constraints, method of Lagrangian multipliers. Function of a complex variable-limit, continuity and differentiation, analytic function, Cauchy-Riemann equations, conjugate functions, application to two dimensional problems, Cauchy's integral theorem, Taylor's and Laurent's expansions, branch points, zeros, poles, residues, simple problems on contour integration.

Text Books:

1. E. Kreyszig, *Advanced Engineering Mathematics*, Wiley publication, 9th Edition,
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publication, Delhi.

Referrence Books:

1. H. Bauer, *Probability Theory and Elements of Measure Theory*, Academic Press, 1981.
2. P.E. Danko, A.G. Popov, T.YA. Koznevnikova, *Higher Mathematics in Problems and Exercises*, Part 2, Mir Publishers, 1983.

2. Energy Conversion System I

A.C circuits- single phase and three-phase A.C. circuits- phasors, phasor diagrams, balanced and unbalanced supply in three-wire and four-wire system; three phase power measurement; definitions of p.f. for unbalanced system; sources of energy- thermal, hydel, nuclear and other non conventional energy sources etc. Introduction on rotating electrical machines- electromagnetic laws, concept of torque due to non alignment of magnetic field, emf induced in a coil rotating in a magnetic field, classification of rotating electrical machine. Transformer- construction, classification, principle of operation, emf equation, phasor diagram and equivalent circuit, performance indices , testing, auto transformer, 3 phase transformers, vector Grouping, parallel operation of transformer, tap changers.

Text Books:

1. S.K.Bhattacharya, *Electrical Machine*, Tata McGraw Hill, 2nd edition, 2007.
2. H. Cotton, A.H.Wheeler ,*Advanced Electrical Technology*,

Referrence Books:

1. I. J. Nagrath and D. P. Kothari, *Electric Machines*, Tata McGraw Hill, 1985.
2. V.D Toro, *Electrical Engineering Fundamentals*, 2nd Edition, Prentice-Hall of India.

3. Network Analysis

Introduction to circuit elements, types of network, network theorems, transient response. Transform of different signal wave forms, initial and final value. Concept of complex frequency, transform impedances, transform circuit and application of network theorem. Concept of poles and zeros, network functions for one port and two port network, restrictions of poles and zeros location for driving point function and transfer function. Time domain behaviour for the poles and zeros plots. Concept of two port network, impedance parameter, admittance parameter, transmission parameter, inverse transmission parameter, hybrid parameter, inverse hybrid parameter, relation between parameter set, interconnection of two networks, network functions for general networks. Graph of a network, trees, co-trees, loops, incidence matrix, cut-set, tie-set matrix, number of possible trees of a graph, mutual inductance, dot convention, co-efficient of coupling, series and parallel

combination of coupled circuit. Classification of passive filters, characteristics, equation of filter networks, resonance, bandwidth and selectivity, quality factor.

Text Books:

1. Franklin Kuo, *Network Analysis And Synthesis*, Wiley international, 2nd edition.
2. M.E. Van Valkenburg, *Network Analysis* , PHI, 3rd edition.

Reference Books:

1. W.H.Hyatt and J.E.Kemmerly , *Engineering Circuit Analysis*, McGraw-Hill.
2. A.E Fitzgerald, David E. Higginbotham, Arvin Grabel, *Basic Electrical Engineering*, McGraw-Hill, 5th Edition.

4. Digital Electronics

Number systems and codes, Boolean algebra, logic gates, tristate logic, minimization using Karnaugh map, NAND and NOR gate implementation. Combinational systems: combinational logic circuit design, code converters , BCD to seven segment decoder, full adder, half adder, 4-bit magnitude comparator, encoders, decoders. Sequential systems: R-S Latch, master-slave, edge/level- triggered flip-flops, design of flip-flops, shift registers, serial and parallel loading; memory: ROM, PROM, EPROM, EEPROM, RAM, introduction to memory organization, circuit design using decoders, MUX and DEMUX etc., design using multiplexers, ROM, PAL, PLA, design of synchronous counters, mod-k or divide-by-k counters, decade counter, BCD counter, ring counters, Johnson or twisted-ring counter, counter application; logic families : TTL, ECL, CMOS, calculation of noise margins, fan in and fan-out.

Text Books:

1. H. Taub and D. L. Schilling ,*Digital Integrated Electronics*, McGraw-Hill, 1977.
2. M. Morris Mano, *Digital Design*, Prentice Hall, 3rd Edition, 2002.

Reference Books:

1. W. I. Fletcher, *An Engineering Approach to Digital Design*, Prentice-Hall 1980.
2. T.M. Floyd , R.P. Jain, *Digital fundamentals*, Pearson Education

5. Object Oriented Programming

A look at procedure-oriented programming, object oriented programming paradigm, basic concepts of object oriented programming, benefits of OOP, object oriented languages. Tokens, keywords, identifiers and constants, basic data types, user-defined and derived data types, type compatibility, reference, variables, scope resolution operator, type casting, implicit conversion, operator precedence, control structures, structure, function. Class specification, class objects, accessing class members, data hiding, empty classes, pointers within a class, passing objects as arguments, returning objects from functions, friend functions and friend classes, constant parameters and member functions, structures and classes, static members, objects and memory resource, class design steps. Constructors, destructor, constructor overloading, order of construction and destruction, constructors with default arguments, nameless objects, dynamic initialization through constructors, constructors with dynamic operations, constant objects and constructor, static data members with constructors and destructors, nested classes. Defining operator overloading, overloading unary operators, overloading binary operators, overloading binary operators using friends, manipulation of strings using operators, rules for overloading operators, type conversions. Deriving derived classes, single, multilevel, multiple, hierarchical, hybrid inheritance, constructors & destructors in derived classes, constructors invocation and data members initialization, virtual base classes, abstract classes, delegation. Pointers to objects, this pointer, pointers to derived classes, virtual functions, implementation of run-time polymorphism, pure virtual functions. Classes for file stream operations, opening and closing a file, file pointers and their manipulations, sequential input and output operations, error handling during file operations, command line arguments. Class templates with multiple parameters, function templates, overloading of template functions, member function templates. Object-oriented analysis and design, procedure oriented development tools, prototyping paradigm.

Text Books:

1. Budd, *Object Oriented Programming*, Addison Wesley,

2. K.R Venugopal, Rajkumar, *Mastering C++*, TMH.

Reference Books:

1. Lip man and Lajole, *C++ Primer*, Addison Wesley.
2. B. Stroustrup, *The C++ Programming language*, Addison Wesley

6. Solid State Devices

Introduction to semiconductor equations and carrier statistics: poisson's and continuity equations,(physics) Fermi-Dirac statistics semiconductor diodes: barrier formation in metal-semiconductor junctions, PN homo- and hetero- junctions; CV characteristics and dopant profiling; IV characteristics; small signal models of diodes, applications, bipolar transistors : I-V characteristics and Elers-Moll model; small signal models; charge storage and transient response field effect devices : JFET/HFET, MIS structures and MOSFET operation; JFET characteristics and small signal models; MOS capacitor CV and concept of accumulation, depletion and inversion; MOSFET characteristics and small signal models.Power semiconductor devices –power diodes - power transistors - SCRs - Triac - GTO - Power MOSFETs – IGBTs etc.- principles of operation and characteristics, device specifications and ratings,

Text Books:

1. B.G. Streetman, *Solid State Electronic Devices*, Prentice Hall of India, New Delhi, 1995.
2. D. A. Neamen, *Semiconductor Physics and Devices (IRWIN)*, Times Mirror High Education Group, Chicago) 1997.

Reference Books:

1. A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, Saunder's College Publishing, 1991
2. J. Millman and A. Grabel, *Microelectronics*, McGraw Hill, International, 1987.

7. Signals and systems

Different types of signals: continuous and discrete, impulse sequence, impulse functions and other singularity functions. Types of system: continuous and discrete linearity, time invariance and causality; convolution: convolution sum, convolution integral and their evaluation; time-domain representation and analysis of LTI systems based on convolution and differential equations and difference equation. Multi input-multi output discrete and continuous systems: transform domain considerations: Laplace transforms and Z-transforms; applications of transforms to discrete and continuous systems-analysis; transfer function, block diagram representation.Fourier series and Fourier transform, sampling theorem, discrete Fourier transform (DFT), estimating Fourier transform using DFT. DTFT, DFT, FFT.

Text Books:

1.A.V. Oppenheim, Schafer, R. W,A.S. Willsky and I.T. Young, *Signals and Systems*, Prentice Hall, 1983
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, *Signals and Systems - Continuous and Discrete*, 4th edition ,Prentice Hall, 1998.

Reference Books:

1. A. Papoulis, *Circuits and Systems*, Modern Approach, HRW, 1980
2. Kuo, B. C, *Automatic Control System*, Prentice Hall of India

4th Semester

1. Energy Conversion System -II

Direct Current Machine: construction, classification, applications, principle of operation, armature winding, emf equation, armature reaction and commutation, losses and efficiency, testing, characteristics of dc motors and generators, starting speed control and breaking of dc motor. Induction machine: construction, classification, rotating magnetic field, principle of operation, slip, power flow diagram, slip-torque characteristics, starting and speed control of induction motor, performance indices, double cage rotor, testing of induction motor, circle diagram, induction generator, crawling and cogging, applications.

Text Books:

1. I. J. Nagrath and D. P. Kothari, *Electric Machines*, Tata McGraw Hill, 1985.
2. S.K.Bhattacharya, *Electrical Machines*, Tata McGraw Hill. 2nd edition, 2007.

Reference Books:

1. M G Say, *Performance and Design of AC machines*, CBS Publishers.
2. A.E. Fitzgerald, C. Kingsley Jr. and S. D. Umans, *Electrical Machinery*, McGraw Hill, 1983.

2. Power System-I

Overhead lines and cables: main component of overhead line, line supports, overhead line insulators, insulating materials, types of insulator, sag and tension, stringing chart, corona, underground cable, load curves, power distribution system, primary and secondary distribution. Substations: classification of substations, major equipment in substation, bus bar configurations, line parameter- resistance, conductance, inductance, capacitance of short, medium and long single and three phase lines, proximity effect, skin effect, Ferranti effect, bundle conductors, effect of earth on the capacitance of the conductors, power factor improvement. Performance of lines: A, B, C, D parameters, short, medium, long lines, transmission efficiency, voltage regulation. Per unit system: per unit impedance, changing the base of per unit quantities, pu impedances of transformer, alternator, advantages of per unit system

Text Books:

1. W.D. Stevenson, *Elements of Power Systems Analysis*, 4th edition, McGraw Hill, 1982.
2. I.J. Nagrath and D.P. Kothari, *Modern Power System Analysis*, Tata McGraw Hill, 2nd Edition, 1989.

Reference Books:

1. J Duncan Glover, Mulukutala S. Sarma and Thomas J. Overbye, *Power System Analysis and Design*, Cengage Learning India Pvt. Ltd. 4th Edition.
2. Arthur R burgen and Vijay Vittal, *Power System Analysis*, Pearson Education.

3. Electrical Measurement & Measuring Instruments

Sensitivity-reliability- accuracy-resolution, error analysis of measurements, classification analogue & digital; Analogue instruments- classification of analog electrical measuring instruments highlighting working principles of indicating, integrating, potentiometric, bridges, electrostatic, electrodynamic, and thermal type instruments; Specific analogue instruments to be covered: moving coil, moving iron (attraction and repulsion types) for voltage and current measurements; single phase wattmeter (induction disc type, electrodynamic type)-modifications required for measuring three phase power, energy meter, power factor meter; VAR measurement, trivector meter; Resistance measurement: low resistance (Kelvin double bridge, dc potentiometer), high/insulation resistance (megger), earth resistance; emf measurement using dc potentiometer; AC bridges: Maxwell(two versions), Anderson, Schering and Wien bridge and measurement of L,C and internal r/loss factor, extension of range for an instrument to measure voltage and current, voltage divider, shunt, instrument transformers, details of CT, working flux, vector diagram, magnitude and phase

angle errors and their computations, specific differences for measuring and protection CTs. Testing of energy meters- phantom loading tests, different types of errors of an energy meter and their remedies, Oscilloscope- construction, working principle, measurement of voltage, time & frequency, Lissajous patterns, digital voltmeter, ammeter, frequency meter, resistance meter, energy meter and digital multimeter.

Text Books:

1. E.W. Golding & F.C.Widdis, *Electrical Measurements & Measuring Instruments*, A.H.Wheeler & Co.
2. Helfrick and Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, Prentice-Hall,

Reference Books:

1. F. K. Harris , *Electrical Measurement.*
2. Ernest Frank , *Electrical Measurement Analysis*.

4. Numerical Methods and Analysis

Solution to algebraic and transcendental equations by regula-falsi method, iteration method, Newton-Raphson method, simultaneous linear algebraic equations by Gauss-Jordon method, Crout's method, factorization method, Gauss-Seidel iterative method, determination of eigen values. Numerical differentiation based on interpolation, numerical integration, a general quadrature formula for equidistant ordinates, the trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Weddles rule, Method of undetermined coefficients, extrapolation method. Numerical solution of ordinary differential equations of first order by Euler's and Runge –Kutta's method.Introduction to interpolation, interpolation with equal intervals, different interpolation methods (Newton-Gregory forward and backward difference formulae), interpolation with unequal intervals, divided differences and table, Newton's divided difference formulae, central difference interpolation formulae (Gauss, Stirling, Bessel formulae), piecewise and spline interpolation, (cubic splines) least squares approximations.

Text Books:

1. Robert J. Schiling and Sandra L. Harris, *Applied Numerical Methods for Engineers using Matlab and C,* Thomsom Asea Pte. Ltd.
2. S.S. Sastry , *Introductory methods of numerical analysis*, 4^{th} edition, PHI Learning Pvt. Ltd., 2005

Reference Books:

1. E. Kreyszig, *Advanced Engineering Mathematics*, 9^{th} edition, Wiley publication
2. S. A. Mollah, *Numerical methods*, T.M.H. publication

5. Analog Electronics

Semiconductor diode characteristics, transistor characteristics, analysis and design of different biasing circuits, h-parameter model of BJT, mid frequency and low frequency analysis of CE, CB and CC amplifier, hybrid-pi model of BJT, high frequency analysis of BJT amplifiers, transistors as a switch; transient switching characteristics of transistors. Analysis and design of different biasing circuits of FET amplifiers small-signal low frequency model of FET, mid frequency and low frequency analysis of CS, CG and CD amplifiers, small-signal high frequency model of BJT, high frequency analysis of FET amplifiers, bode plots. General theory of feedback, stability of feedback amplifier, different feedback topologies effect of different parameters of an amplifier, frequency response of 2pole/3 pole feedback amplifiers, bode plot, gain and phase margin, compensation, method analysis, design examples. Differential amplifiers using BJT and FET characteristics of op-amp, ideal and non ideal properties, high frequency effects on op-amp gain and phase, bodes plot slew rate limitation, linear and non-linear circuit applications of op-amps, spice analysis of op-amp circuit integrator differentiator ,comparators, Schimitt trigger (inv and non-inv), triggerable and non-triggerable multivibrator, triangular and sinusoidal wave generators, precision rectifier, gyrator network, frequency dependent negative resistance (FDNR), peak detector, Wein bridge oscillator, phase shift oscillator, quadrature oscillator. Oscillators, harmonic oscillators, tuned oscillator, Colpits oscillator, Hartely oscillator. Voltage regulators, design of series voltage regulator, series regulator with current pre-regulator.

Text Books:

1. J. Millman and A. Grabel,, *Microelectronics*, McGraw Hill, International, 1987.
2. J. Millman and C. C. Halkias., *Electronic Devices and Circuits*, McGraw-Hill, New York.

Reference Books:

1. A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, Saunder's College Publishing, 1991
2. R. *Boylestad* and L. *Nashelsky*, *Electronic Devices and Circuit Theory*, Prentice Hall Publishing Co

6. Elective-I

5th Semester

1. Energy Conversion System -III

Synchronous machine: construction, classification, application, non salient pole synchronous machine: working principle, emf equation, distribution factor and pitch factor, armature reaction, equivalent circuit, phasor diagram, calculation of synchronous reactance, performance indices, isolated and parallel operation of synchronous generator, power angle characteristics, V-curve , load sharing, starting of synchronous motor, hunting, short circuit transient in synchronous machine. Salient pole synchronous machine: two reaction theory, determination of Xd and Xq. Single phase motor: classification of single phase motor and their applications, single phase induction motor- double revolving field theory, equivalent circuit, torque- slip characteristics, performance calculations, single phase synchronous motor, single phase commutator motors.

Text Books:

1. I. J. Nagrath and D. P. Kothari, *Electric Machines*, Tata McGraw Hill, 1985.
2. E. Fitzgerald, C. Kingsley Jr. and S. D. Umars, *Electrical Machinery*, McGraw Hill, 1983.

Reference Books:

1. M G Say, *Performance and Design of AC machines*, CBS Publishers.
2. A.F Puschtein & T.C. Lloyd, *Alternating Current Machines*, John Wiley & Sons.

2. Power System II

Symmetrical fault and unsymmetrical faults: symmetrical components single line diagram for a balanced system, analysis of three phase fault, construction of sequence networks under fault conditions (L-G, L-L, and L-L-G). Analyses of unsymmetrical faults using symmetrical components. Load flow analysis: static load flow equation, system variables, bus admittance matrix, bus classification, Gauss Seidel, Newton-Raphson and fast-decoupled load flow methods, comparison of methods. Power System transient Stability: synchronous generator connected to an infinite bus, power angle curve, steady state, transient, swing equation, equal area and criteria of stability. Brief ideas about power system protection and circuit breakers: general requirements of circuit breakers. Different types of circuit breakers, their construction, operating principles and relative merits and demerits. Fundamental principles of protective relays, their properties and block diagrams.

Text Books:

1. W.D. Stevenson, 'Elements of Power Systems Analysis', 4th Edition, McGraw Hill, 1982.
2. I.J. Nagrath and D.P. Kothari, 'Modern Power System Analysis', 2nd Edition. TMH, New Delhi, 1989.

Reference Books:

1. J Duncan Glover, Mulukutala S. Sarma and Thomas J. Overbye, *Power System Analysis and Design*, Cengage Learning India Pvt. Ltd. 4th Edition.
2. Olle I. Elgerd, *Electric Energy Systems Theory-An Introduction*, Tata McGraw Hill.

3. Microprocessors and Microcontrollers

Microprocessor architecture- address / data and control lines, timing diagrams, internal registers, interrupt mechanism (hardware/software), DMA mechanism - [NB. study mainly based on Intel 8085 and other popular microprocessors]. Detailed description of a typical microprocessor (preferably 8085 & 8086). Interfacing with support chips, signals and timing details along with hardware/software interfacing techniques. I/O interfaces with switch, multisegment display, ADC/DAC. Assembly language programming of 8 bit and 16 bit microprocessors : instruction cycle, machine cycle, T states. Instruction set, addressing modes, stack subroutine, interrupt service routines. Example programs in assembly languages. Concept and operation of assembler and cross assembler. Microcontrollers and embedded processors- difference between a microprocessor and

microcontroller criteria for choosing a microcontroller. Architecture, memory interface and programming concepts of some microcontrollers including 8051, development of application programs in assembly language using 8051. I/O interfacing standards. Microprocessor based system design aids and troubleshooting techniques.

Text Books:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085A/8080A, Wiley Eastern Limited.
2.Muhammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Inc., Fifth Edition, 2003.

Reference Books:

1. I. Liu, G. A. Gibson, Microcomputer Systems: The 8086/8088 Family, 2nd Ed., Prentice Hall, 1986.
2. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991
Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996

4. Control System-I

Introduction to control systems, classification, examples, feedback control systems, properties of control systems, stability, steady-state & transient errors, disturbance rejection, insensitivity and robustness, errors and error constants, system types, control system components, modelling in frequency domain, reduction of multiple system, time response, transient & steady state response of second order system and ramp response of second order system, system response with additional poles and zeros, concept of dominant poles, control actions- proportional, integral, derivative, and their combinations. Stability of linear systems-Routh-Hurwitz criterion, Nyquist criterion, root locus, stability margins, effects of system gain on stability, design via frequency response- lag, lead, lag-lead compensator, case study.

Text Books:

1. N. N. Nise ,*Control Systems Engineering* , 4th edition, Wiley & Sons
2. I.J. Nagrath and M. Gopal, *Control System Engineering*, 2nd edition, Wiley Eastern

Reference Books:

1. Richard F Vancil, Gopal , *Control Systems-Principles and Design*, Tata McGraw-Hill Education
2. B.C. Kuo, *Automatic Control Systems*, 4th edition, Prentice Hall of India.

5. Electromagnetic Field Theory

Electrostatic field: dielectric interface, Laplace and Poisson's equations, energy & force. Steady currents: continuity equations, Ohm's law, Joule heating, current flow in materials, Eddy current, skin effect, displacement current. Magnetostatic field: Ampere's circuital law, scalar & vector potentials, Laplace and Poissions equations. Electromagnetic induction: Maxwell's equations; power flow and Poynting vector. Solutions of field equations in rectangular, cylindrical and spherical coordinate system, radiation generation, propagation of electromagnetic waves, various boundary value problems, principle of electromagnetic radiation & interaction with matter; scientific and engineering applications of electromagnetic radiation.

Text Books:

1. W H Hayt & J A Buck, *Engineering Electromagnetic*, 7th Edition, Tata McGraw Hill.
2. J D Krauss, *Electromagnetic with application*, 5th Edition, Tata McGraw Hill.

Reference Books:

1. J. A. Edminister , *Schaum's outline of theory and problems of electromagnetics*, 2nd edition, McGraw- Hill Professional
2. A Pramanik, *Electromagnetism – Theory and Applications*, Prentice-Hall of India

6th Semester

1. Power Electronics

General introduction of power electronics, scope and applications review of power semiconductor devices, their protection, heat management and drive circuits. Switching losses and snubbers. Diode rectifiers and operating characteristics. Principles of phase angle control- single-phase & three phase semi-converters and full converters. Inverter operation, effects of source inductance, dual converters, single stage ac to ac conversion: single-phase and three-phase ac voltage controllers, cycloconverters. Principles of switched mode dc to ac conversion: single-phase and three phase voltage source inverters; modes of operation, voltage control and waveform control. PWM principles, current source inverters. Choppers: principle of operation & modes of operation. Basic principles of switched mode dc-dc power conversion- isolated and non isolated converter configurations.

Text Books:

1. N. Mohan, T. M. Undeland, W. P Robbins, *Power Electronics: Converter, Applications & Design*, 3rd edition, Wiley & Sons.
2. B. W. Williams, *Power Electronics: Devices, Drivers and Applications*, Macmillan, London

Reference Books:

1. C. W Lander, *Power Electronics*, 3rd Mc Graw Hill
2. L. Umanand, *Power Electronics*, Wiley India Pvt. Ltd.

2. Control System-II

State variable analysis: introductory matrix algebra and linear vector space state space representation of systems, conversion of state space model to transfer function model, linearization, solution of state equations evaluation of state transition matrix (STM) canonical forms similarity transformation and invariance of system properties due to similarity transformations, controllability and controllable canonical form, pole assignment by state feedback, observability and observable canonical forms, design of observer observable duality, observer based controller design. Digital Control: introduction to digital control system, mapping of s-plane into z-plane, transient response, characteristics of z-plane pole-locations, stability of z-plane pole locations damping ratio and natural frequency, stability on z-plane, Jury's stability criterion, digital compensator design in frequency domain, lead, lag and lag-lead compensation single loop digital controllers two term (PI, PD) and three term (PID) control algorithm design, digital compensators, implementation of digital controllers, solution of state difference equations of linear discrete control systems, evaluation of state transition matrix using similarity transformation, controllability and observability of discrete data control system.

Text Book:

1. Norman N. Nise , *Control Systems Engineering*, Wiley & Son.
2. B.C. Kuo, *Automatic Control Systems*, 4th edition, Prentice Hall of India.

Reference Books:

1. M. Gopal, *Control Systems*, 3rd Edition, McGraw hill.
2. K. Ogata, *Modern Control Engineering*, 5th Edition. Prentice Hall.

3. Digital Signal Processing

Design of fir digital filters: window method, frequency sampling method, Park-McClellan's method. Design of IIR digital filters: bilinear transformation, butterworth, chebyshev and elliptic approximations; frequency transformation lowpass, bandpass, bandstop and high pass filters.

Structures of DSP: direct, parallel, cascade and lattice, effect of finite register length in FIR filter design, limit cycle in IIR filters. Introduction to multi-rate signal processing. Hardware implementation considerations in DSP, selected aapplications of digital signal processing.

Texts Books:

1. S. K. Mitra, *Digital signal processing: A computational approach*, Tata McGraw Hill
2. A.V. Oppenheim and R.W. Schafer, *Discrete Time Signal Processing*, Prentice Hall,

References Books:

1. L.R. Rabiner and B. Gold, *Theory and Application of Digital Signal Processing*, Prentice Hall,
2. J.R. Johnson, *Introduction to Digital Signal Processing*, Prentice Hall, 1992.

4. Industrial Instrumentation

Measurement of non-electrical quantities: transducers- ddefinition and introduction, classification: active/passive, primary/secondary, etc.; specific transducers: strain gauge, LVDT, thermistor and thermocouple. Static and dynamic characteristics of sensors, resistive, inductive and capacitive sensors and signal conditioning circuits, PH and conductivity sensors, piezo-electric and ultrasonic sensors and its application in process and biomedical instrumentation. Measurement of viscosity, humidity and thermal conductivity, nucleonic gauges: sources and detectors and its application. Interfacing sensors and actuators; lab view programs. Instrumentation system design. Optical sensors including infrared, laser and optical fiber.

Text Books:

1. D Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw Hill
2. A.E. Fribance, *Industrial Instrumentation Fundamentals*, McGraw Hill.

Reference Books:

1. Donald P. Eckman, *Industrial Instrumentation*.
2. E.O. Doebeline & D. N Manik, *Measurement Systems Application and Design*, 5th edition, McGraw-Hill.

5. Principles of Communication Engineering

Analog communication : introduction to communication systems, signals and spectra, electromagnetic spectrum and its usage, communication channels and propagation characteristics, amplitude modulation and demodulation - spectra, circuits and systems, frequency modulation/demodulation, frequency division multiplexing, pulse modulation and demodulation , performance of analog communication systems in AWGN. Digital communication: A-D conversion, quantization and companding, PCM, DPCM, ADPCM, DM, ADM, time division multiplexing, baseband transmission, data regenerators and clock recovery, inter-symbol interference, equalizers, digital modulation and demodulation ASK, FSK, PSK and their spectra, circuits and systems, carrier recovery.

Text Books:

1. S.S. Haykin, *An Introduction to Analog and Digital Communication Systems*, Wiley Eastern 1989
2. R.B. Carlson, *Communication Systems*, 3rd international edition, McGraw Hill, 1986.

Reference Books:

1. B.P. Lathi, *Communication Systems*, John Wiley, 1987.
2. H. Taub and D.L. Shilling, *Principles of Communication Systems*, McGraw Hill international student edition,1971.

7th Semester

1. Engineering Economics:

Introduction – engineering economy and its important, want activity satisfaction of wants. Resources planning and distribution in economic system – Laissez Faire and socialism. Factors of production and concept of optimum. Laws of return. Demand - elasticity of demand, demand – estimation, market research, supply and industrial costs. Money – value of money, quantity theory; inflation and deflection. Neural network and its applications. Banking - role in commercial banks credit and its importance in industrial financing, sources of finance Reserve bank of India and its functions. Business management and organization, proprietorship, partnership and joint stock company – their formation, finance and management. Elements of taxation, insurance, business combinations. Basic principals of management. Industrial record keeping : double entry system – journal, ledger, trial balance, cash book, preparation of final accounts, trading and profit and loss account and balance sheet. Industrial costs and their classifications – material cost control, labour cost control and overhead cost control. Depreciation and replacement studies; financial control ratio analysis and their interpretation for industrial control. Budgetary control.

Text Books:

1. H L Ahuja, *Business Economics* , S Chand's & Company Ltd.
2. Sampat Mukherjee, *Managerial Economics*, New Age International (P) Ltd.

Reference Books:

1. O P Chhabra, *Managerial Economics*, Tata McGraw Hill

2. Electrical Drives

Basic power electronic drive system components. Different types of loads, shaft-load coupling systems, selection of motor power ratings, review of starting, braking and speed control of DC and IM, transient analysis during starting braking & speed control of dc & ac drives, calculation of energy loss, stability, single phase and three phase converter fed dc motor drive. Four quadrant operation, constant flux operation and field weakening, chopper fed drives, braking and speed reversal of dc motor drives using choppers, three phase induction motor drives - ac voltage controlled drives –- VSI fed induction motor drive – stator side control – scalar control and vector control – rotor side control - slip power recovery scheme - CSI controlled induction motor drives. Regeneration in drives: dynamic braking, regenerative braking, dc injection, plugging. Basic concepts of synchronous motor drives, switched reluctance motor drives and permanent magnet motor drives.

Text Books:

1. W. Leonhard, *Control of electrical drives*, Springer, 1995.
2. R.Krishnan, *Electric Motor Drives – Modeling, Analysis and Control*, Prentice-Hall of India Pvt Ltd., New Delhi, 2003.

Reference Books:

1. Bimal K.Bose, *Modern Power Electronics and AC Drives*, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
2. M Chilikin, *Electric Drives*, Mir Publication.

3. High Voltage Engineering

Breakdown phenomenon: breakdown in gases - mechanism of breakdown in gases, Townsend's ionization coefficients, Paschen's Law, time lags for breakdown, streamer breakdown theory. Breakdown in liquids - suspended solid particle mechanism, cavitation and bubble mechanism,

stressed oil volume mechanism, etc. Breakdown in solids - intrinsic breakdown, electromechanical breakdown, breakdown of solid dielectrics in practice, chemical and electrochemical deterioration and breakdown, breakdown due to treeing and tracking, breakdown due to internal discharges. Overvoltage phenomenon, protection & insulation coordination: natural causes for overvoltage - lightning phenomenon, over voltage due to switching surges and due to arching ground. Line design based on lightning. Basic idea about protection against overvoltage - lightning arresters, surge absorbers, ground wire, grounding practices etc. BIL, SIL of the equipments, v-t curve, concepts of insulation coordination. Generation of high ac & dc voltage: high ac voltage generation - testing transformer and its cascaded connections. Single phase resonant circuits. High dc voltage generation - single stage and multi stage voltage multiplier circuits. Impulse voltage and current generation: introduction to impulse current and voltage, impulse generator circuits, analysis of circuit "a" and "b". Multistage impulse generator circuits, triggering and synchronisation of impulse generator with CRO impulse current generator circuits and its analysis. Measurement of high voltage and current : electrostatic voltmeter, Chubb and Fortescue method of measuring peak value of a.c., sphere gap method, rod gap method of measuring high voltage, impulse voltage measurement using potential dividers, impulse voltage and current measurement using CRO. High voltage testing : testing of overhead line insulators, bushing, power transformer, circuit breakers etc. Loss in dielectric, measurement of resistivity, dielectric constant and loss factor. Testing of transformer oil, high voltage schering bridge, wagner earthing technique, concept of partial discharge.

Text Books:

1. C. L. Wadhwa, *High Voltage Engineering*.
2. M.S Naidu & V Kamaraju , *High Voltage Engineering.*

Reference Books:.

1. E. Kuffel and WS Zaengl, *High Voltage Engineering*-Fundamentals, Pergamon Press.
2. Alston , *High Voltage Technology* , Oxford University Press.

3. **Elective-1I**
4. **Elective-III**
5. **Project- I**

8th Semester

1. Industrial Management

Introduction to management, evolution of scientific management, modern management. Principles. Elements of management; Planning, organizing, staffing, directing, coordinating, reporting, budgeting. Core concepts of marketing. Need, want, demand, product, value, satisfaction, marketing mix- product, price, place, promotion. Financial management, objectives, scope, techniques of investment analysis, pay- back period, accounting rate of return, working capital, cost of capital. Sources of financing. Technology management. Product design. Types of production system. Plant location-factors to be considered. Plant layout. Types of layout. Inventory management. Significance of HRM. HR planning job evaluation. Recruitment and selection. Placement and induction. Training. Performance appraisal. Compensation. Industrial relations. Microeconomics. Demand and supply. Forecasting techniques. Cost and revenues. Competitive nature of firms. Keynesian economics. Aggregate demand and supply. Employment determination. National income. Trade cycle. Inflation. Index numbers. Capital budgeting. Cash flow analysis. Balance sheet. Risk analysis and decision making. Impact of liberalization, privatization and globalization. Locating the firm in a global economy. Fiscal policy. Taxation-principles. Exchange rate determination. Monetary policy. Functions of banks. Credit creation by commercial banks.

Text Books:

1. P.Kotler, *Marketing Management*, 12th edition, Pearson
2. P.Chandra, *Financial Management Theory and Practice*, 3rd edition, Tata McGraw Hill,

Reference Books:

1. K.Ashwathappa, *Human Resources and Personnel Management*, 3rd edition, Tata McGraw Hill
2. E.S.Buffa & R.K.Sarin, *Modern Production/Operation Management* , 8th edition, Wiley.

2. Electrical Machine Design

Designing an electrical machine – a paradigm shift from studying an electrical machine; converting & expressing electrical quantities and equations involving length, breadth, cross-section, etc, specifications for commencing a design; the three major sub-areas: electromagnetic, thermal & mechanical; use of empirical formulas, use of assumed constants, lack of clear mathematical relations make designing a repetitive task; no optimum but optimal design; use of computers.
Transformer: initial values to be assumed, core design, window dimension design, yoke design, overall dimension design, LV winding design, HV winding design, checking the design output with specification: calculation of resistance, reactance, losses, efficiency, regulation, no load current, designing cooling system. Rotating machine: general concepts and constraints in design of rotating machines; output equation in terms of main dimensions, specific magnetic & electric loadings and speed; factors affecting the size of machines; choices of both specific loadings; separation of D & L for different types of machines. Output equation of induction motor – choice of average air gap flux density – choice of ampere conductor per metre - main dimensions –stator winding design - stator slots design – stator teeth & core - rules for selecting rotor slots of squirrel cage machines – design of rotor bars & slots – design of end rings – design of wound rotor -– magnetic leakage calculations – leakage reactance of poly phase machines- magnetizing current - short circuit current – circle diagram - operating characteristics.

Text Books:

1. M G Say, *Performance and Design of ac machines*, CPS Publishers
2. S. K. Sen, *Principles of Electrical Machine Design with Computer Programmes*, Oxford and IBH Publishing Co. Pvt Ltd.

Reference Books:

1. R.K. Agarwal, *Principles of Electrical Machine Design*, S.K.Kataria & Sons
2. A.K. Sawhney, *A Course in Electrical Machine Design*, 6th edition, Dhanpat Rai and Sons

3. **Elective-IV**
4. **Elective-V**
5. **Grand Viva**
6. **Project- II**

Elective-I

1. Applied Thermodynamics

Definition: Thermodynamic system, control volume, thermodynamic properties, processes, cycles, homogenous and heterogeneous system, thermodynamic equilibrium, quasi-static process, work transfer, pdv work, indicator diagram, free expansion, path function. First law of thermodynamics: quantity of energy and its measurement, first law energy equation for closed and open loop system under SSSF and USUF condition, application of first law energy equation to thermodynamic system components such as boiler, turbine, compressor, nozzle, expander, pump, condenser, first law efficiency, first law analysis of combustion process. Second law of thermodynamics, quality of energy and its measurements, reversible and irreversible processes, entropy and its significance, principle of increase of entropy of the universe, Carnot cycle, Clausius inequality, application of second law to various thermodynamic system, combination of first and second law, first and second law combined, reversible adiabatic work in a steady flow system, unsteady flow, control system analysis, control volume analysis, entropy and disorder, availability and irreversibility, second law analysis of combustion process, air standard cycles, Otto-cycle, Diesel cycle, limited pressure cycle, comparison of Otto and Diesel and dual cycle, Brayton cycle, Stirling cycle and Ericsson cycle. Simple vapour cycles, Rankine cycle, actual vapour cycle processes, comparison of Rankine and Carnot cycle, reheat cycle, regenerative cycle, binary vapour cycles

Text/Reference Books :-

1. Nag, P.K., *Engineering Thermodynamics*, 3rd edition, Tata McGraw-Hill, 2005
2. Cengal, Y.A and Boles, M.A, *Thermodynamics: An Engineering Approach*, 5th edition, McGraw Hill, 2006.
3. Rajput, R.K.,*Thermal Engineering*
4. Ballaney, P.L,*Thermal Engineering*, Khanna Publishers

2. Fluid Mechanics

Properties of fluid: Mass and weight density, specific gravity, specific volume, viscosity and Newton's law of viscosity, compressibility, types of fluid, surface tension and capillarity, pressure and its measurement: fluid pressure at a point and pascal's law, absolute, gauge and vacuum pressures, pressure variation in a fluid at rest, pressure measurement-manometers and mechanical gauges. Hydrostatics: Total pressure and centre of pressure for horizontal, vertical, inclined plane surfaces and curved surfaces submerged in liquid. Total pressure and centre of pressure on lock gates. Buoyancy and flotation: Buoyancy, centre of buoyancy , metacentre and metacentric height and equilibrium of floating bodies, period of oscillation .Kinematics of flow: Types of fluid flow, continuity equation in three dimensions, velocity potential function and stream function, forced and free vortex flow. Dynamics of flow: Euler's equation and Bernoulli's equation , application of Bernoulli's equation-venturimeter, orifice-meter, and pitot tube. Orifice and notches: Flow through orifices, hydraulic coefficients, time of emptying hemispherical and horizontal cylindrical tank through an orifice at it's bottom, discharge over rectangular, triangular and trapezoidal notches, velocity of approach. Laminar flow : Flow of viscous fluid through circular pipe-velocity distribution and average velocity, Hagen Poiseiulle formula, kinetic energy correction and momentum correction factors , Navier-Stokes equation of motion. Turbulent Flow: Reynold's experiment, Loss of head due to friction in pipes, Reynold's expression and Prandtl mixing length theory for turbulent shear stress. Flow through Pipes: Major and minor losses of energies in pipes,

hydraulic gradient and total energy lines, flow through pipes in series, equivalent pipe, flow through parallel pipes, power transmission through pipes and nozzles, water hammer.

Text/Reference Books :-

1. Bansal, S.K., *Fluid Mechanics & Hydraulic Machines*, Laxmi Publications.
2. Cengel, Y.A., *Fluid Mechanics: Fundamentals & Applications (SI Units)*, Tata McGraw- Hill Publications
3. Jain, A.K., *Fluid Mechanics*, Khanna Publishers.
4. Rajput, R.K., *Fluid mechanics & Hydraulic machines* , S. Chand Publications.

3. Strength of Materials

Stress, strain, types of stresses, elastic limit, Hook's law, Analysis of bars of varying sections, law of superposition, composite bar, thermal stress, thermal stresses in composite bars, elongation of bar due to it's own weight, stress-strain diagram. Introduction , longitudinal & lateral strain, Poisson's ratio, volumetric strain for rectangular bar, bulk modulus , principle of complementary shear stress, relation between various elastic constants. Principle planes and principle stresses, methods for determining stresses on oblique section, analytical method, graphical method, Mohr's circle, use of Mohr's circle to find principle stresses. Types of beams and loads, S.F & BM diagram for a cantilever, uniformly distributed load, simply supported beam for various types of loading, relation between load, shear force and bending moment diagram. Theory of simple bending, expression for bending stress, bending stresses in symmetrical sections, section modulus, section modulus for various shapes of beam sections, bending stress in unsymmetrical sections, deflection of various types of beams. Basic assumptions and derivation of shear stress produced in a circular shaft subjected to torsion, torque transmitted by a circular and hollow circular shaft, polar modulus, strength of a shaft and tensional rigidity, composite shafts, combined bending and torsion, strength of a shaft of varying cross section.

Text/Reference Books :-

1. Ramamurtham, S., "Strength of Materials", Dhanpat Rai & Sons, 1974.
2. Bansal, R.K., "*Strength of Materials"*, Laxmi publications.
3. Beer, Johnston., "*Mechanics of Materials"*, Tata McGraw-Hill Publications

4. Electrical Engineering Materials

Crystallography: Crystalline and amorphous solids, periodic structures – Lattice, basis, unit cell, bravais lattice, crystal structure and symbols, millar indices reciprocal lattice. X- ray crystallography: X- ray diffraction , Bragg's law , determination of lattice constant, atomic form factor, closest packing of spheres, packing efficiency , crystal defects, band theory of solids, Kronig – Penny model, Brillouin zones, electronic distinction between conductors , insulators and semiconductors, dielectric properties of materials: polarisation and dielectric constant, frequency and temperature dependence of relative permittivity behaviour of dielectric under alternating fields, dielectric losses. Conductors: Electrical conductivity of metals, Lorentz theory, free electron theory, electron scattering, resistivities of conductors including alloys. Semiconductors: Intrinsic and Extrinsic semiconductors, Fermi-Dirac distribution, dependence of carrier concentration on temperature, measurement of resistivity, four probe method, Hall effect, measurement of carrier concentration, Zener breakdown phenomenon, photo-electric effect in semiconductors. magnetic properties of materials: diamagnatism, paramagnatism, ferromagnetism, exchange interaction, antiferromagnatism, ferrimagnetism, and ferrites, magnetic resonance, magnetotriction , Curie-Weiss law , Curie law, Curie temperature of ferromagnetic material, soft and hard magnetic material. Ni-Fe alloy and applications, Alnic, Alcomax and application. special materials, ceramics, polymers, XLPE, nanostructures and nanomaterials, biomaterials and bioceramics. Superconductivity: Superconductivity phenomena, meissner effect, type I and type II, superconductors, high TC Superconductors, Josephson junction, SQUID.

Text/Reference Books :-

1. A.J. Dekker, *Solid State Physics*, Tata McGraw-Hill Publications
2. C. Kittel, *Introduction to Solid State Physics*, Wiley & sons
3. R L Singhal , *Solid State Physics*, Macmillan *Publishing* Co .
4. S.O. Pillai ,*Solid State Physics*, McGraw Hill Publisher

Electives II, III, IV& V

S.No.	Title	Lecture	Tutorial	Practical	Credit
1	Special Topics in Electrical Engineering I				
2	Special Topics in Electrical Engineering II				
3	Dynamics of Electrical Machine	3	0	1	4
4	Generalized Theory of Electrical Machine	3	1	0	4
5	Power Plant Engineering	3	1	0	4
6	Advanced Power systems	3	0	1	4
7	Process Control & Instrumentation	3	0	1	4
8	Opto-electronics Instrumentation	3	0	1	4
9	Industrial Automation and Control	3	0	1	4
10	Advanced power electronics and Drives	3	0	1	4
11	Laser and Nonlinear Optics	3	0	1	4
12	Optical Engineering and Laser Instrumentation	3	0	1	4
13	Energy Science and Engineering	3	1	0	4
14	Solar Photovoltaic Systems	3	0	1	4
15	Network Synthesis	3	1	0	4
16	Modelling and Simulation of Electrical systems	0	1	6	4
17	Embedded Systems	3	0	1	4

1. Special Topics in Electrical Engineering I

Details syllabus and reference will be given in class at the beginning of semester

2. Special Topics in Electrical Engineering II

Details syllabus and reference will be given in class at the beginning of semester

3. Dynamics of Electrical Machines

Basic concept- review of torque-speed characteristics of different types of motor, factors affecting the study of machine's dynamics. General drive equation, single excitation and double excitation system & their comparison. DC machine dynamics: current and speed expression during starting, role of starter in dynamics of starting, current and speed expression during dynamic braking and computation of braking time, dynamics of counter current braking and current and speed expression, dynamics of series motor starting, dynamics of dc drives controlled by thyristors. Induction machine dynamics: dynamics of starting of induction motor, dynamics of braking of induction motor, computation of braking time, energy loss during dynamic operating condition, procedure for reducing energy loss during transient process. Reactive power consideration in induction motor operation & stability. Synchronous motor: - review of power equation & p-s relationship, dynamic condition in alternator following load change, oscillation under dynamic disturbances (Generator mode), pulling in phenomenon.

Text Books:

1 .P.C.Krause, O.Wasynczuk, *Electromechanical Motion Devices*, McGraw Hill
2. Paul C. Krause, *Analysis of Electric Machinery* , McGraw- Hill,

Reference Books:

1. M G Say, *Performance and Design of AC Machines*, CBS Publishers
2. A.F Puschtein & T.C. Lloyd, *Alternating Current Machines*, John Wiley & Sons

4. Generalized Theory of Electrical Machines

Introduction to generalized theory: elementary energy converter of Gibbs and Adkins, transformer with movable secondary, transformer voltage and speed voltage, transformation from 3-phase to 2-phase, rotating axes to stationery axes, transformed impedance matrix, torque calculation. Application to dc machine, voltage-current relationship, generator and motor operation, steady state and transient analysis, sudden short circuit, sudden application of inertia load, electric braking stability of dc machines, application to induction machine, voltage-current relationship, steady state analysis, transient analysis, electric braking, general stability of induction machine, application to synchronous machine, voltage-current relationship, power in synchronous machine, analysis with damper windings, determination of d-axis and q-axes reactance, short circuit study of synchronous generator

Text Books:

1 .Bimbhra P.S. , *Generalized Theory of Electrical Machines* , Khanna Publishers
2. Bernerd Adkins, *The General Theory of Electrical Machines*. Chapman and Hall

Reference Books

1 .Morgan A. T. *General Theory Of Electrical Machines*, Heyden
2. Jones C. V., *Unified Theory Of Electrical Machines* , Butterworth

5. Power Plant Engineering

The introduction of the various sources of the energy, principal types of the power plants and combustion of fuels, the various cycles used in power plants, viz., Rankine cycle, regenerative cycle, binary vapour cycle, otto cycle, diesel cycle, duel combustion cycle, gas turbine cycles. Description of different aspects of steam power plant, layout of a modern steam power plant, fuel handling, combustion equipment for steam boilers, ash handling, dust collection, chimney draught, boiler accessories, steam nozzles, steam turbines, cooling towers, cooling ponds etc. IC engines used in such a plant and essential components of diesel power plants, combustion phenomenon in IC engines, its related topics, layout of a diesel engine power plants, general aspects of gas turbine used in such a plant along with the description of gas power cycle used in such turbines, operation of gas turbines, gas turbines power plants layout. Elements of hydro-electric power plant, hydro-electric turbines, plant, layout, hydro-electric plant controls, hydrology. General aspects of nuclear engineering, nuclear power systems, nuclear reactors and their description, nuclear energy, advantages of combined operation of plants, load division between power stations, hydro-electric plant in combination with steam or nuclear power plants, co-ordination of hydro-electric and gas turbine stations, co-ordination of different types of power plants.

Text Books:

1. M.M.El-Wakil , *Powerplant Technology* , McGraw Hill
2. Arora & Domkundwar , *A Course in Power Plant Engineering* , Dhanpat Rai

Reference Books

1. B.G.A. Skrotzki &W.A.Vopat, *Power Station Engineering & Economy* , Tata McGraw Hill
2. M.V.Deshpande, *Elements of Electrical Power Station Design*, Wheeler

6. Advanced Power systems

Load frequency control: multi area load frequency control problem and concept of tie line control, speed governing system, AVR, AGC, economic operation of power system, introduction- incremental fuel rate curves, incremental fuel cost curve, constraints in economic operation of power system, cost function control for economic operation of a two area power system. Voltage control: methods of voltage control, tap changing transformer, HVDC operation and control: CIA, CC and CEA control. Determination of stable operating point. Introduction to FACTS – brief description of various FACTS devices and their principle of operation, role of FACTS in active and reactive power control. Harmonics in Power Systems – different sources of harmonics, effects of harmonics on power system performance and power quality. Introduction to SCADA and security monitoring.

Text Books:

1. A. J. Wood and B.F. Wollenberg, *Power Generation, Operation and Control*, 2nd edition, John Wiley.
2. K.R.Padiyar , *HVDC Power Transmission Systems – Technology & System Interaction*, Willey Eastern

Reference Books

1. E.W.Kimbark, *Direct Current Transmission*, Vol 1,Wiley Interscience
2. N.G.Hingorani & L.Guygyi, *Understanding Facts*, IEEE Press

7. Process Control & Instrumentation

Concept of processes and units: process statics, mass and enthalpy balance, modelling of process dynamics process control terminology, process instrumentation diagrams, modelling of chemical processes, single loop control of standard first order process plants, controller implementation: Electronic analog, digital, pneumatic controllers. P, P-I, P-D, P-I-D control, controller tuning, Ziegler-Nichlol's method, frequency domain design. Feed-forward control, ratio control, multi-loop and cascade control, interaction and decoupling non-linear effects in plants and controllers. Simulation of process control systems, boiler drum level control, discrete controllers: Selection of sampling intervals, stability analysis. Concepts of modulating and sequential control, structure of modulating control loops, self-tuning and multifunction controllers, control valves. Process Actuators: electrical, pneumatic, hydraulic, valve positioners. Industrial instrumentation systems:

components, structure, specification, self tuning and adaptive controllers. Supervisory control : objectives and implementation.

Text Book:

1. George Stephanopoulos, *Chemical process control: an introduction to theory and practice* , Prentice-Hall
2. D. Patranabis, *Principles of process control*, Tata McGraw Hill

Reference Book:

1. William L. Luyben, *Essential of Process Control*, McGrraw Hill.
2. Surekha Bhanot, *Process Control - Principles And Applications* , Oxford University Press

8. Opto-electronics Instrumentation

Introduction to electromagnetic field theory, ray and wave optics, polarization and isotropic and anisotropic media. Opto electronic devices: sources-LED, laser, laser diode, broadband calibration sources, detectors-photodiode-P-N, P-I-N, photo multiplier tubes and APD, broadband thermal detector; modulators-intensity, polarization, phase, read out schemes for modulation-polarimeter, interferometer. Transportation media: waveguide theory- slab wave guide, scalar wave equation. Optical fibre as a cylindrical waveguide, optical fibre characteristics- absorption and dispersion; fibre-optic polarizer, attenuator, coupler and polarization splitter. Optoelectronic sensors and system- sensor as a modulator, bulk modulator, fibre-optic modulator. Sensing principles-electrooptic and magneto-optic (polarimetric and interferrometric), magnetostriction based sensors, distributed fibre-optic sensors-OTDR and OFDR principles in temperature measurement, fibre - optic gyro. Holographic measurement and its biomedical applications. Optoelectronic integrated circuit and integrated optic sensor. .

Text Book:

1. G. P. Agrawal, *Fiber-Optic Communication System*, 3rd Edition, Wiley Student Edition
2. Amnon Yariv, PochiYeh , *Photonics: optical electronics in modern communications*, 6th edition, Oxford University Press.

Reference Book:

1. C. K. Sarkar, *Opto Electronics And Fibre Optics Communication*, New Age International (P) Ltd
2. Clifford R. Pollock, *Fundamentals of optoelectronics*, Irwin

9. Industrial Automation and Control

Brief introduction about industrial processes and their automation; elements of pneumatic, hydraulic and electrical control systems; valves and actuators; stepper motors; PID controllers and their tuning; implementation of digital controller; control strategies for industrial processes; programmable logic controller; real-time issues on signal transmission and control; communication systems for industrial automation; data acquisition and supervisory control; control of discrete manufacturing processes; intelligent systems for monitoring ,s supervision and control; case studies of industrial control systems.

Text Book:

1. Stephanopoulos, G., " Chemical Process Control: An Introduction to Theory and Practice ", Prentice-Hall, New Jersey, 1984.
2. Coughanowr, D. R. and L. B. Koppel, “Process systems Analysis and Control ", Mc-Graw-Hill, 2nd. Ed., 1991.

Reference Book:

1.W.A. Wolowich, “Automatic control systems, basic analysis and design”,
2. B.C. Kuo, Automatic Control Systems, 4th Edn., Prentice Hall of India

10. Advanced Power Electronics

Current source inverter. Ideal single phase CSI operation, analysis and waveforms - analysis of single Phase capacitor commutated CSI. Switched mode rectifier - operation of single/ three phase bilateral bridges in rectifier mode(synchronous link). Control principles. Control of the DC side voltage principle of operation of flyback, forward, push-pull, half bridge, full bridge & isolated Cuk converters, input & output filter design, multi-output operation of isolated converters, MMF equations. Design of transformers and inductors. Introduction to resonant converters . Classification of resonant converters . Basic resonant circuit concepts . Load resonant converter . Resonant switch converter . Zero voltage switching, zero current switching, clamped voltage topologies .

Text Book:

1. Ned Mohan, Undeland and Robbin, *Power Electronics: converters, Application and design*, John Wiley and sons.
2. Robert W. Ericson, *Fundamentals of Power Electronics*, Chapman & Hall

Reference Book:

1. Bose, Bimal K, *Power Electronics and AC Drives*, Prentice-Hall India
2. L. Umanand, *Power Electronics: essentials and application*, Wiley

11. Laser and Nonlinear Optics

Rigorous diffraction theory: Diffraction of a Gaussian beam, Fresnel and Fraunhofer diffraction, application to different apertures. Fourier optics: Fourier transforming property of a thin lens, spatial frequency filtering and its applications. Coherence theory: Partial coherence, holography, construction and reconstruction of hologram. Lasers: Two-level and three-level lasers, electromagnetic theory of optical fibres and wave guides. Scalar wave equation, modes of a fibre and planar wave guides. Periodic media: Bragg diffraction and Bragg devices. Nonlinear optics: second harmonic generation: optical phase conjugation, optical bistability, solitons, self and cross phase modulations; optical Bloch equation. Electro-optic effects in different crystals, acousto-optic effects, Raman-Nath diffraction and acousto-optic devices .

Text Book:

1. R.L. Sutherland, D.G. McLean,S. Kirkpatrick **,** *Handbook of nonlinear optics*,2nd edition, Marcel Dekker.
2. Robert W. Boyd, *Nonlinear optics*, 3rd edition, Academic Press.

Reference Books

1. A.Yariv, P. Yeh , *Optical waves in crystals: propagation and control of laser radiation* , Wiley.
2. A. E. Siegman, *Lasers*, University Science Books.
3. O. Svelto, *Principles of Laser*, 5th edition

12. Optical Engineering and Laser Instrumentation

Optical fields and waves – their interaction with bulk and structured matter; engineering principles for optical materials, components and systems; lasers and their related technologies; principles and devices based on electro-optics, acousto-optics, magneto –optics, guided wave-optics and harmonic generation; methods of Q-switching, mode-locking and ultra short pulse generation; laser based methods and systems for measurement and sensing, interferometry, holography, speckle, fiber and Fourier Optics.

Text Book:

1. AmnonYariv, PochiYeh, *Optical waves in crystals: propagation and control of laser radiation,* Wiley.
2. OrazioSvelto , *Principles of Laser* ,Springer.

Reference Books

1. P Das , *Laser And Optical Engineering*, Springer
2. G. P. Agrawal , *Nonlinear Fiber Optics* , Academic Press.

13. Energy Science and Engineering

Energy resources: terminology, major energy resources in use: resource, reserve and availability of Oil, gas and coal in global and national context. Hydro-electricity and nuclear-electricity: availability and developmental constraints. Energy consumption demand: consumption sectors; growth rate in industrial, commercial & residential, agriculture and transportation sector of total energy and electricity national and international trends. Renewable Energy: need for accelerated growth, availability and environmental constraints of traditional non-renewable sources. Demerits of solar sources. Technologies for electricity generation: wind, PV and biomass; tidal and geothermal power plants. Ocean thermal and wave electricity generation.Fuel cells. Energy storage: role of storage in electricity supply, hydrogen energy. Energy management and audit: demand side and supply side of management (DSM & SSM): conservation of electrical energy, conservation act, 2001. Energy audit: Preliminary detailed audit.

Text Book:

1. B.H. Khan, *Non-Conventional Energy Resources*, McGraw Hill.
2. J. Andrews, N. Jelley , *Energy Science Principles, Technologies and Impact*, Oxford University Press.

Reference Books:

1. D.S. ChauhanS.K.Srivastava , *Non Conventional Energy Resources*, New Age Int.(P) Ltd.
2. P. Gevorkian , *Sustainable Energy Systems Engineering* , McGraw Hill.

14. Solar Photovoltaic Systems

Introduction to semiconductor Physics, theory of P-N junction, operation of P-N junction as solar cells, parameters of solar cells, design of solar cells, solar cell materials and technologies, fabrication of crystalline Si solar cells, solar PV modules, PV module output as function of temperature and solar radiation, solar geometry, availability of solar radiation at a given location, solar PV systems and components, solar PV water pumping system, introduction to power electronic devices, off-grid and grid-connected PV systems, charge controller, DC-DC converter, DC-AC inverter, maximum power point tracking, energy storage options for solar PV systems, design of off-grid PV systems, design of grid-connected PV systems, hybrid PV Systems, life cycle cost analysis.

Text Book:

1. R.A. Messenger, J. Venture , *Photovoltaic Systems Engineering*, CRC Press.
2. R. Foster, M. Ghassemi, A. Cota, *Solar Energy* , CRC Press.

Reference Book:

1. S.P. Sukhatme , *Solar Energy* , Tata McGraw Hill.
2. C.S. Solanki , *Solar Photovoltaics*, Printace Hall of India.

15. Network Synthesis

Positive real function –synthesis of 2 port, R-L-C networks, cascading and interconnection, bisection theorem, synthesis of R-L and R-C filters-Butterworth, Chebyschev, Bessel type frequency transformations. Active networks and synthesis techniques. Synthesis of R-L-C, low pass, high pass, band pass and band reject filters. Biquad and simulation of physical systems and active networks.

Text Book:

1. Kuo, Franklin F, *Network Analysis and Synthesis*, John Wiley and sons, Singapore, 1966
2. D Roy Chaudhury, *Network Analysis and Systems*, New Age International, New Delhi, 1996

Reference Book:

1. M.E. Van Valkenburg, *An Introduction to Modern Network Synthesis* ,Wiley. Eastern Ltd..

2. Harry Y. F. Lam , *Analog and digital filter design and realization*, Prentice Hall

16. Modelling and Simulation of Electrical Systems

Modelling and Simulation of DC and AC machines, Power electronics converters, Linear Time Invariant systems, Transmission and distribution systems. Load flow analysis, Circuit simulation and PCB layout, signal processing and data acquisition using software, Learning about virtual instrumentation, finite element analysis etc.

17. Embedded Systems

Introduction to Embedded Systems; Embedded Systems Hardware: Processors - Digital Signal Processors, Microcontrollers, Special Purpose Processors, I/O devices, interfacing and control - Analog I/O, Digital I/O, Bus I/O, Serial and Network I/O, Memory, Power and Display Devices - Reconfigurable and Custom Logic Devices, System Hardware Design Case Study; Embedded Systems Software : Introduction to Operating Systems, Real Time Operating Systems, Device Drivers; Embedded Systems Application Design and Programming Environments : System Specification and Modelling, Programming, Simulation and Verification, Performance Analysis and Optimisation; Selected Application Case Studies from areas such as : Instrumentation and Signal Processing Systems, Control and Actuation Systems, Power Electronic Drive Systems etc; Embedded Systems Testing.

Text/ Reference Books:

1. Santanu Chattopadhyay, “Embedded System Design”, PHI Learning Pvt. Ltd.

2. Andrew N. Sloss, Dominic Symes, Chris Wright. “ARM System Developers Guide: Designing and Optimizing System Software”, Elsevier

3. Richard Barnett, Larry O’Cull, Sarah Cox, “Embedded C Programming and the Microchip PIC”, Delmar Cengage Learning.

4. P Lapsley, DSP Processor Fundamentals -Architecture and Features, Chand Publications

5. Hamid.A.Toliyat and Steven G.Campbell, “DSP Based Electro Mechanical Motion Control”, CRC Press New York, 2004

6. Wayne Wolf,” FPGA based system design “, Prentice hall, 2004.

7. Real-time Systems - Jane Liu, PH 2000.

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