

## SEMESTER 1

### 08O101 CALCULUS AND ITS APPLICATIONS

3 2 0 4

**BASIC CONCEPTS:** Limits and Continuity-Revision. (2)

**MAXIMA AND MINIMA:** Maxima and minima of two variables, Constrained maxima and minima- Lagrange multiplier method. (4)

**INTEGRAL CALCULUS:** Evaluation of multiple integrals, Change the order of integration, Application of multiple integrals to find area and volume- Applications to engineering problems. Beta and Gamma Integrals- Evaluation of definite integrals in terms of Beta and Gamma functions. (8)

**ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER:** Basic concepts, Geometrical meaning, Separable differential equations . Modeling: Separable equations. Exact differential equations, Integrating factors, Linear differential equations, Bernouli equations- Applications to engineering problems. (8)

**LINEAR DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER:** Homogeneous linear equations of second order and higher order equations with constant coefficients. Euler-Cauchy equation, Non-homogeneous equations, Solution by variation parameter, - Applications to engineering problems. (10)

**VECTOR CALCULUS:** Differentiation of vectors –Gradient, Divergence, Curl, Directional derivatives. Line ,Surface integrals- Statement of Green's ,Gauss Divergence and Stoke's Theorems- Applications to engineering problems. (10)

**Total 42**

#### TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2004.
2. George B, Thomas Jr. and Ross L Finney, "Calculus and Analytical Geometry", Addison Wesley, 2004.

#### REFERENCES:

1. Ray Wylie C and Louis C Barrett, "Advanced Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd, 2003.
2. Riely K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering", Cambridge University Press, 2002.

### 08E102 APPLIED PHYSICS

(Also Common with 08C102/ 08M102/ / 08L102/ 08Y102/ 08P102/ 08Z102/ 08A102/ 08T102/ 08I102/ 08B102/ 08D102/ 08U102)

3 0 0 3

**ULTRASONICS:** Introduction. Production – magnetostriction effect, magnetostriction generator, inverse piezoelectric effect, piezoelectric generator. Ultrasonics detection, Properties, Cavitation. Industrial applications – drilling, welding, soldering and cleaning. Non Destructive Testing – pulse echo system, through transmission, resonance system. Medical applications – cardiology, neurology, ophthalmology, ultrasonic imaging (9)

**LASER TECHNOLOGY:** Introduction. Principle - spontaneous emission, stimulated emission, Population inversion. Pumping mechanisms. Types of lasers - He-Ne, CO<sub>2</sub>, Nd:YAG, Excimer, Dye lasers, Semiconductor laser. Applications - Spectroscopic analysis of materials, lasers in microelectronics, drilling, welding, heat treatment, cutting, holography, defence and ranging. (9)

**FIBER OPTICS AND SENSORS:** Principle. Modes of propagation. Fabrication techniques – rod and tube method, crucible-crucible technique. Classification based on materials, refractive index profile, modes. Splicing. Losses in optical fiber. Light sources for fiber optics. Detectors. Fiber optical communication links. Fiber optic sensors - temperature, displacement, voltage and magnetic field measurement. (8)

**QUANTUM PHYSICS AND MICROSCOPY:** Development of quantum theory. Dual nature of matter and radiation - de Broglie wave length. Uncertainty principle. Schroedinger's equation-Time dependent, Time independent. Particle in a box. Limitations of optical microscopy. Electron microscope. Scanning electron microscope, Transmission electron microscope, Scanning Transmission Electron Microscope, applications. (8)

**VACUUM SCIENCE AND TECHNOLOGY:** Introduction. Concepts of vacuum- Throughput, Pumping speed, Effective pumping speed and Conductance. Types of pumps - Working principle and construction of rotary pump, diffusion pump, turbo molecular pump. Operation of pressure gauges - pressure range, measurement of vacuum using Pirani and Penning gauges, merits and limitations. Working of a vacuum system Applications and scope. (8)

**Total 42**

#### TEXT BOOKS:

1. Avadhanulu M N and Kshir Sagar P G, "A Text Book of Engineering Physics", S. Chand & Company Ltd., New Delhi, 2007.
2. Rao V V, Ghosh T B and Chopra K L, "Vacuum Science and Technology", Allied Publishers Limited, New Delhi, 1998.

**REFERENCES:**

1. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007.
2. Kannan M D and Balusamy V, "Engineering Physics", Vikas Publishing House, New Delhi, 2003.
3. Palanisamy P K, "Engineering Physics", Scitech Publications, Chennai, 2002.
4. Ageov N, Zuev A I and Kokora A, "Laser and Electron Beam Materials Processing", Mir Publications, Moscow, 1998

**08E103 APPLIED CHEMISTRY**

(Also Common with 08L103/ 08Z103/ 08I103/ 08U103)

**3 0 0 3**

**WATER:** Hardness-harmful effects in various industrial application. Softening- Zeolite processes, demineralization process. Boiler troubles and remedies, removal of oils and silica, internal conditioning, treatment of water for municipal supply, break point chlorination, desalination by electrodialysis and reverse osmosis, water quality parameters and standards for drinking and construction - WHO and Indian standards. (10)

**WATER ANALYSIS:** Principles of determination of Total, temporary, permanent, calcium and magnesium hardness by EDTA method. Determination of chloride, sulphate, BOD, COD, turbidity, pH, TDS, nitrogen, phosphate etc. Determination of alkalinity and Laglier saturation index. Importance of all these terms. Simple numerical problems. Spectrophotometric determination of Fe in water. Flame emission spectroscopy- determination of Na and K in water. (10)

**POLYMER AND PLASTICS:** classification, functionality of monomers, molecular weight of polymer. Polymerization reactions – chain, condensation, copolymerization and co-ordination polymerizations, synthetic rubber, thermo plastics and thermosets, compounding of plastics, polymer processing by injection, extrusion and blow moulding techniques. Polymers for building industry-floorings, roofing, special coatings. (7)

**THERMODYNAMICS:** Temperature dependence of enthalpy – thermochemistry - curing of cement, second law of thermodynamics, entropy and second law, spontaneity of chemical reactions, properties of Gibbs free energy. Free energy and spontaneity, absolute entropy and third law of thermodynamics. (10)

**ELECTROCHEMISTRY:** Conductometric titrations – applications. Electrode potential, cells, Nernst equation, galvanic and concentration cells, pH and potentiometric titrations – applications. Determination of Laglier saturation index-importance. (5)

**Total 42****TEXT BOOKS:**

1. Jain P C and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2002.
2. Atkins P, "The Elements of Physical Chemistry", Oxford University Press, New Delhi, 2001.
3. Gopalan R, Venkappayya D and Nagarajan S, "Engineering Chemistry", Vikas publishing house private Ltd., New Delhi, 1999.

**REFERENCES:**

1. Kumaravel M, Kaniappan K, Murugavel S C and Senthilkumaar S, "Engineering Chemistry", R. K. Publishers, Coimbatore, 2003.
2. Sheik Mideen A, "Engineering Chemistry – I", Meenakshi Agency, Chennai, 2002.

**08O104 COMMUNICATION SKILLS IN ENGLISH****3 0 2 4**

**READING:** Reading Practice on a variety of subjects to develop Reading skills such as identifying main ideas and using contexts for vocabulary. (General and semi-technical articles from Newspapers and Science Magazines) (10)

**WRITING:** Fundamental Principles of clear writing – Style and tone in formal writing with Exercises. (5)

**MECHANICS OF WRITING:** Grammar in context- focus areas – Tenses, Prepositions, Modals, Adjectives, Transformation of sentences. (7)

**TECHNICAL WRITING:** Definition, Description, Instructions, and Writing Technical Papers. (4)

**TRANSCODING:** Interpreting Graphics and Writing coherent paragraphs. (2)

Writing for focus (2)

**MIND MAP:** Organisation of Coherent Paragraphs and Essays, (2)

Cloze Test to improve Vocabulary, syntax and reading skills (4)

Letter Writing and Short reports (6)

**PRACTICALS:**

**SPEAKING:** Practice in Speech Making Process –To develop Communicative Ability – Techniques for speaking fluently, using body language, developing fluency and confidence.

Short Speeches (10)

Group Discussions and Role-plays (8)

Listening Activities (10)

**Total 70**

**TEXT BOOKS:**

1. Teaching Material prepared by the Faculty, Department of English
2. Sankaranarayanan V, Sureshkumar S and Palanisamy, "Technical English for Engineering Students", PHI, 2008.

**REFERENCES:**

1. Rodney Huddleston and Geoffrey K Pullam, "A Student's Introduction to English Grammar", Cambridge University Press, U K, 2005.
2. Bert Decker, "The Art of Communicating", Decker Communications, Inc., USA, 2004.
3. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practice", Oxford University Press, U K, 2004.
4. Dr. AjayRai, "Effective English for Engineers and Technologies : Reading, Writing & Speaking", Crest Publishing House, New Delhi, 2003.
5. Paul V Anderson, "Technical Communication: A Reader – Centered Approach", Asia Pte. Ltd., Singapore, 2003.
6. Albert Joseph, "Writing Process 2000", Prentice Hall, New Jersey, 1996

**08E105 PROBLEM SOLVING AND C PROGRAMMING**

(Also Common with 08C105/08M105//08L105/ 08P105/08A105/08T105/08B105/08D105/08H105/ 08U105 )

**2 0 2 3**

**INTRODUCTION TO PROBLEM SOLVING:** Program development- Analyzing and Defining the Problem- Modular Design- Algorithm-Flow Chart. (3)

**PROGRAMMING LANGUAGES:** What is programming language-Types of programming language- Program Development Environment. (2)

**C:** The C character set – Identifiers and keywords – Data types – Constants – Variables – Arrays – Declarations – Expressions – Statements – Symbolic constants – Operators & expressions – Arithmetic operators – Unary operators – Relational & logical operators – Assignment operators – Conditional operators – Library functions – Data input & output functions. (4)

**CONTROL STATEMENTS:** While statement – Do While statement – For – Nested loops – if else – Switch – Break – continue – comma operator – go to statement – programs. (2)

**FUNCTIONS:** Defining a function – Accessing a function – Passing arguments to functions – Specifying arguments data types – Function prototypes – Storage classes – auto – Static – Extern and register variables. (3)

Arrays: Defining an array – Processing array – Passing array to a function – Multi dimensional array – Array & strings. (3)

**Pointers:** Declarations – Pointers to a function – Pointer and one dimensional arrays – Operating a pointer – Pointer and multi dimensional arrays – Arrays of pointers – Passing functions to other functions. (4)

**STRUCTURES AND UNIONS:** Definitions – Processing a structure – User defined data types – Structures and pointers – Passing structure to functions – Self referential structures. (2)

**FILES:** Open – Close – Process – Operations on a file. (3)

Preprocessor Directives - Command Line Arguments. (2)

**Total 28**

**TEXT BOOKS:**

1. Kernighan B W and Ritchie D M, "C Programming Language (ANSI C)", Pearson Education, 2004.
2. Herbert Schildt, "C – The Complete Reference", McGraw Hill, 2001
3. Michael Schneider G, Steven W , Weingart and David M Perlman, "An Introduction to Programming and Problem Solving with Pascal ", John Wiley and Sons, 1998.

**REFERENCES:**

1. Gottfried B," Programming With C", Mc Graw Hill, 2004
2. Deitel H M and Deitel P J, "C : How To Program", Pearson Education, 2001

## 08E106 ELECTRIC CIRCUITS

2 1 0 2.5

**INTRODUCTION:** System of Units – Electrical Quantities - Circuit elements – Independent and Dependent Sources – Ohm's Law – Kirchhoff's Laws – Analysis of Circuits using Kirchhoff's Laws – Circuits with Dependent Sources – Wye  $\leftrightarrow$  Delta Transformation – Analysis using PSpice. (6)

**AC CIRCUITS:** Introduction to Time Varying and Alternating Quantities – Average and RMS (effective) Values – Form Factor – Phasor Relationships for Circuit Elements – Steady State Solution using Phasor Algebra – Analysis using Kirchhoff's Laws. (5)

**POWER:** Power Triangle - Power Factor. (3)

**MESH AND NODAL ANALYSIS:** Loop Analysis - Mesh Equations for Circuits with Independent Current Sources – Mesh Equations for Circuits with Dependent Sources – Analysis using PSpice. (6)

**NODAL ANALYSIS:** Node Equations for Circuits with Independent Voltage Sources – Node Equations for Circuits with Dependent Sources – Analysis using PSpice. (6)

**NETWORK THEOREMS:** Superposition – Source Transformation – Thevenin's and Norton's Theorems – Maximum Power Transfer Theorem – Analysis using PSpice. (8)

**RESONANCE:** Resonance in Series and Parallel RLC Circuits – Bandwidth – Quality Factor – Selectivity. (8)

**Total 42**

### TEXT BOOKS:

1. Navhi M and Edminister J A, "Theory and Problems of Electric Circuits", Tata McGraw-Hill Publishing Company Limited, New Delhi, Fourth Edition, 2007.
2. Sudhakar A and Shyammoan S Palli, "Circuits and Networks – Analysis and Synthesis", Tata McGraw-Hill Publishing Company Limited, New Delhi, Third Edition, 2007.

### REFERENCES:

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw-Hill Publishing Company Limited, New Delhi, Third Edition, 2007.
2. Jack E Kemmerly, Steven M Durbin and William H Hayt Jr., "Engineering Circuit Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, Seventh Edition, 2006.
3. David Irwin J, "Basic Engineering Circuit Analysis", Macmillan Publishing Company and Colier Macmillan Publishers New York, London, Third Edition, 1990.

## 08E110 ENGINEERING GRAPHICS

(Also Common with 08C110//08Y110/08Z110/08B110/08D110/08H110/08U110/08L210/08T210/08I210)

2 0 3 3.5

**INTRODUCTION:** Introduction to Engineering Drawing. BIS. Principles of dimensioning (5)

**ORTHOGRAPHIC PROJECTION:** Principles of orthographic projection-projection of points, straight lines, planes and solids. Orthographic projection of simple engineering components – missing view exercises. (10)

**PICTORIAL PROJECTIONS:** Principles of pictorial views, isometric view of simple engineering components. Orthographic views from given pictorial views. Isometric views from given two or three views. (5)

**SECTION OF SOLIDS:** Section of regular solids, types of sections, selection of section views. Sectional views of simple engineering components. (5)

**DEVELOPMENT OF SURFACES:** Development of lateral surfaces of regular solids and truncated solids. (5)

**Total 30**

### TEXT BOOK:

1. Venugopal K, Prabhu Raja V, "Engineering Graphics", New Age International Publishers, 2007.

### REFERENCES:

1. Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS New Delhi, 2004
2. Natarajan K V, "Engineering Drawing and Graphics", M/s Dhanalakshmi N, Chennai, 2007.

## SEMESTER 2

### 08O201 LINEAR ALGEBRA AND FOURIER SERIES

3 2 0 4

**LINEAR ALGEBRA:** Euclidean n-space, General vector spaces, Subspaces, Linear independence, Basis and dimension, Row and column spaces, Rank, Finding bases, Inner product spaces, Length and Angle in inner product spaces, Orthonormal bases; Gram Schmidt process, Change of basis. (12)

**LINEAR TRANSFORMATIONS:** Introduction, Properties-Kernal and range, Linear Transformation from  $R^n$  to  $R^m$ , Matrices of linear transformations (7)

**EIGEN VALUES AND EIGEN VECTORS:** Eigen values and Eigen vectors, Diagonalization, Orthogonal Diagonalization, Symmetric Matrices, Quadratic Forms and its Applications. (7)

**FOURIER SERIES:** Dirchlet's conditions, Statement of Fourier theorem, Fourier coefficients, Change of scale, Half range series. (6)

**BOUNDARY VALUE PROBLEMS:** Separable partial differential equations-Classical equations and Boundary value problems, One dimensional wave equations, One dimensional heat equations, two dimensional heat equations - Solution by Fourier series. (10)

Total 42

#### TEXT BOOKS:

1. Howard Anton and Chris Rorres, "Elementary Linear Algebra", John Wiley & Sons, 2005.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2004.

#### REFERENCES:

1. Dennis G Zill and Michael R Cullen, "Advanced Engineering Mathematics", Jones and Barlett Publisher, 2005.
2. David C Lay, "Linear Algebra and its Applications", Addison-Wesley, 2004.
3. Ray Wylie C and Louis C Barrett, "Advanced Engineering Mathematics", Tata McGraw-Hill Publishing Company Ltd, 2003.

### 08E202 MATERIALS SCIENCE

(Also Common with 08L202/ 08Z202/ 08I202/ 08U202 )

3 0 0 3

**CRYSTALLOGRAPHY:** Crystal systems. Lattice parameters, Bravais lattices. Packing Factors of cubic and HCP crystal systems. Miller indices. Linear and planar density of atoms. Debye - Scherrer method of crystal structure. Crystal Imperfections - point, line and surface defects and their role in electrical, mechanical and optical properties of materials. (8)

**METALS AND ALLOYS:** Drude Lorentz theory of electrical conduction, Wiedemann Franz law, Band theory of solids. Factors affecting resistivity of metals – temperature, alloying, magnetic field and strain. Applications of conductors – Strain gauges, transmission lines, conducting materials, precision resistors, heating elements and resistance thermometer. (5)

**SEMICONDUCTING MATERIALS AND DEVICES:** Elemental and compound semiconductors. Intrinsic and extrinsic semiconductors - Properties. Carrier concentration in intrinsic semiconductors. Carrier concentration in n-type and p-type semiconductors. Material preparation - Czochralski's technique and zone refining technique. Hall effect - Hall coefficient in extrinsic semiconductors, experimental determination of Hall coefficient. Application of Hall effect. Semiconductor devices – LDR, LED, Photodiode, Solar Cells and LCD. (9)

**DIELECTRIC MATERIALS AND DEVICES:** Qualitative study of various polarization. Electric dipole moment determination. Effect of temperature and frequency on dielectric constant. Dielectric loss. Ferroelectric materials – classification - BaTiO<sub>3</sub> and PZT - Piezoelectric materials. Applications of ferroelectric and piezoelectric materials. Breakdown mechanisms. Classification of insulating materials on temperature basis. (6)

**MAGNETIC MATERIALS AND DEVICES:** Ferro and ferri magnetic materials – Properties. Heisenberg and domain theory of ferromagnetism. Hysteresis. Ferrite – structure and properties. Applications - floppy disks, CD ROM, Magneto optical recording. (6)

**ADVANCED MATERIALS:** Nanophase materials - Synthesis techniques, properties, applications. Shape Memory alloys (SMA) – Characteristics, properties of NiTi alloy, application in MEMS. Superconductivity. Types of superconductors - High T<sub>c</sub> superconductors, comparison with low T<sub>c</sub> superconductors. Application of superconductors. Metallic glasses – Preparation, properties, applications. (8)

Total 42

#### TEXT BOOKS:

1. William D Callister Jr., "Material Science and Engineering", John Wiley and sons, New York, 2006.

2. Leonid V Azaroff and James J Brophy, "Electronic Processes in Materials", McGraw Hill Co, New York, 1991.

**REFERENCES:**

1. Jayakumar S, "Materials Science", R.K.Publishers, Coimbatore, 2007.
2. Palanisamy P K, "Materials Science ", SCITECH Publications, Chennai, 2002.
3. Raghavan V, "Materials Science and Engineering- A First Course", Prentice Hall of India, New Delhi, 2001.
4. Srivatsava J P, "Elements of Solid State Physics", Prentice Hall of India, New Delhi, 2001.

**08E203 CHEMISTRY OF ELECTRONIC MATERIALS**

(Also Common with 08L203/ 08Z203/ 08I203/ 08U203 )

**3 0 0 3**

**PRINCIPLES OF POLYMER SCIENCE:** Polymerisation reactions– types-examples, degree of polymerization and average molecular weights. Thermoplastics and thermosetting resins - examples. Electrical, mechanical and thermal properties related to chemical structure. Insulating materials, polymer alloys, composites. (8)

**ELECTRONIC APPLICATIONS OF POLYMER:** Charge transport in conjugated polymers – Electrical properties of doped conjugated polymers- applications and scope. Non linear optical properties of polymers. Polymers for light emitting diodes, photopolymers and photo resists for electronics. Conducting polymer based MEMS and biosensors. (10)

**ORGANIC ELECTRONIC MATERIALS:** Charge transfer complexes, organic light emitting diodes, organic semiconductors and transistors- structure, stability and fabrication methods. (6)

**ADVANCED MATERIALS:** Carbon nanotubes and carbon fibres, fullerenes, polymer nano-composites, shape memory alloys, metallic glasses, solid oxide materials, Polymer electrolytes , super conducting oxides. (8)

**PROCESSING OF ELECTRONIC MATERIALS:** Zone refining for high purity silicon, Ceramics for electrical insulation and magnetic applications. Photo and electroluminescence materials. Materials for optic fibres. Principles and applications of PVD and CVD, MCVD for optic fibre production. (10)

**Total 42**

**TEXT BOOKS:**

1. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006.
2. Pletcher D, "Industrial Electrochemistry", Chapman and Hall, London, 1993.

**REFERENCES:**

1. Kenneth G Budinski and Michael K Budinski, "Engineering Materials: Properties and Selection", Prentice Hall, Eighth Edition, 2004.
2. Ian P Jones, "Materials Science for Electrical and Electronic Engineers", Oxford University Press, 2001.
3. William F Smith, "Foundations of Materials Science and Engineering" McGraw Hill, 2000.

**08E204 NETWORK THEORY**

**2 1 0 2.5**

**THREE PHASE CIRCUITS:** Phase sequence- Line and phase quantities - Phasor diagram - Balanced and unbalanced Wye, Delta loads – Analysis of balanced load - Analysis of unbalanced load - Neutral shift method.

**POWER MEASUREMENTS IN THREE PHASE CIRCUITS:** Single and two Wattmeter methods – Balanced and unbalanced Wye, Delta loads - Power factor calculation - Reactive power measurements-PSPICE analysis of 3 phase circuits. (9)

**MAGNETICALLY COUPLED CIRCUITS:** Mutual inductance – Co-efficient of coupling - Dot convention - Analysis of coupled circuits, Ideal transformer, Ideal auto transformer - Analysis of single tuned and double tuned circuits - PSPICE analysis of coupled circuits. (8)

**NETWORK TRANSIENTS:** Transient concepts – Singularity functions – unit step, unit impulse - Transient response of simple RL, RC and RLC series and parallel circuits for step input and sinusoidal excitation - Laplace Transform application to the solution of RL, RC & RLC circuits: Initial and final value theorems and applications - concept of complex frequency - driving point and transfer impedance - poles and zeros of network function - Transient analysis using PSPICE (10)

**TWO PORT NETWORK:** Two port network parameters – Interconnection of two port networks: parallel, series and cascade – T -  $\pi$  Equivalent networks. (5)

**FILTERS AND ATTENUATORS:** Low pass, High pass, Band pass, band stop filters – constant K and m-derived filter – Attenuators – T type,  $\pi$  Type , Lattice attenuator (4)

**NETWORK SYNTHESIS:** Realisability concept – Hurwitz property - Positive realness - Properties of positive real functions - Synthesis of RL, RC and LC driving point impedance functions using simple canonical networks - Foster and Cauer forms. (6)

**Total 42**

**TEXT BOOKS:**

1. Sudhakar A, and Shyammohan S Palli, "Circuits & Networks – Analysis and Synthesis", Tata McGraw-Hill Publishing Company Limited, New Delhi, Third Edition, 2007.
2. Navhi M, and Edminister J A, "Theory and Problems of Electric Circuits", Tata McGraw-Hill Publishing Company Limited, New Delhi, Fourth Edition, 2007.

**REFERENCES:**

1. Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw-Hill Publishing Company Limited, New Delhi, Third Edition, 2008.
2. Jack E Kemmerly, Steven M Durbin, and William H Hayt Jr, "Engineering Circuit Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, Seventh Edition, 2006.
3. Gopal G B, Prem R C and Duresh C K, "Engineering Network Analysis and Filter Design", Umesh Publications, First Edition, Reprint, 2003.
4. Umesh Shinha, "Network Analysis and Synthesis", Satya Prakashan, New Delhi, Reprinted Edition, 1997.

**08E205 ELECTRONIC DEVICES****3 1 0 3.5**

**P-N JUNCTION DIODE:** V-I characteristics - static and dynamic resistance, Temperature dependence of characteristics, diffusion and transition capacitances, Diode as a circuit element, small signal and large signal models. Elementary applications - Clippers and clampers, Diode switching times, p-n junction diode ratings. Breakdown phenomena in diodes - zener diodes. The metal - semiconductor junction - Schottky barrier diodes. (9)

**BIPOLAR JUNCTION TRANSISTOR:** Physical behaviour of a BJT – Ebers - Moll model, large signal current gains. Modes of transistor operation - Common base, common emitter and common collector configurations, Input and output characteristics, Early effect, regions of operation. AC and DC load lines - Need for stability of Q-Point. Bias stability - fixed bias, collector to base bias, self bias. Transistor switching times - Transistor as a switch and an amplifier. High frequency effects. BJT ratings. Introduction to phototransistors. (9)

**JUNCTION FIELD EFFECT TRANSISTOR:** JFET operation - V-I characteristics, transfer characteristics, regions of operation. DC analysis - JFET biasing. Small signal JFET model, JFET as a switch, voltage variable resistor and an amplifier. (6)

**MOSFET:** Constructional details - Operation of enhancement and depletion type MOSFETs , V-I characteristics, transfer characteristics, analytic expression for drain current. Comparison of PMOS and NMOS devices - MOSFET biasing, MOSFET as a switch, resistor and amplifier. Introduction to CMOS devices. (8)

**INTEGRATED CIRCUIT FABRICATION:** Monolithic IC technology - Planar processes, Epitaxial growth, Oxidation, Photolithography, Diffusion, Ion implantation, metallization. BJT fabrication - need for buried layer, Junction and dielectric isolation, Fabrication of p-n-p, multiple emitter transistors. Monolithic diodes. Fabrication of FETs, NMOS enhancement and depletion MOSFETs, self isolation, CMOS technology. Monolithic IC Resistors: sheet resistance - diffused, ion implanted, epitaxial, pinch, MOS and thin film resistors. Monolithic IC capacitors - junction, MOS and thin film capacitors. IC packaging. Microelectronic circuit layout. (10)

**Total 42****TEXT BOOKS:**

1. Millman J and Grabel A, "Microelectronics", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition, 2000.
2. Boylestead L R and Nashelsky L, "Electronic Devices and Circuit theory", Pearson Education India, New Delhi, Ninth Edition, 2006.

**REFERENCES:**

1. Adel S Sedra and Kenneth C Smith, "Microelectronic Circuits", Oxford University Press, Newyork, Fourth Edition, 1998.
2. Thomas L Floyd, "Electronic Devices", Pearson Education India, New Delhi, Seventh Edition, 2007.
3. David A Bell, "Electronic Devices and Circuits", Prentice Hall of India, New Delhi, Fourth Edition 2000.

**08E210 ENGINEERING PRACTICES**  
(Also common with 08L110, 08I110, 08Z210, 08D210, 08U210)

**0 0 2 1****CYCLE – I**

1. Study of different types of Lamps (CFL Lighting, LED Lighting, Flood Lighting, Multi-arm fitting) - Measurement of Illumination Levels
2. Stair-case Wiring – Implementation
3. Construction of Regulated Power Supply – Measurement of Voltage Level
4. Construction of an Oscillator – Measurement of Frequency and Amplitude using Oscilloscope
5. Installation of Multimedia – PC System

## CYCLE – II

1. Welding - Metal Arc Welding and Gas Welding.
2. Machine Tools I - Demonstration of Drilling Machine and Lathe
3. Machine Tools II – Demonstration of CNC Lathe and Machining Center
4. Automation – Demonstration of Automation Systems
5. Automobile Engineering – Study of Automobile and Power Transmission

### REFERENCES:

Laboratory Manual, Prepared by EEE, ECE & Mechanical Department.

## 08E211 / PHYSICS LABORATORY

(Also Common with 08L211/08Z211/08I211/08U211)

**0 0 3 1.5**  
**(Annual)**

1. Magnetic Hysteresis
2. Resistivity of Metals and Alloys - Carey Foster Bridge
3. Band gap of Semiconductor - Post Office Box
4. Efficiency of a solar cell
5. Band Gap of Semiconductor – Reverse Saturation Current
6. Electrical and Thermal conductivity of Metallic wire - Wiedemann Franz Law
7. Temperature Coefficient of Resistance - Post Office Box
8. Characteristics of Photo Diode
9. Lattice Parameters – Powder Photograph Technique.
10. Demonstration of determination of laser parameters

### REFERENCES:

Laboratory Manual, Prepared by Physics Department

## 08E212 CHEMISTRY LABORATORY

(Also Common with 08L212/ 08Z212/ 08I212/ 08U212 )

**0 0 3 1.5**  
**(Annual)**

1. Anodizing aluminium and determination of thickness of anodic film
2. Electroplating of nickel and determination of cathode efficiency
3. Constructing of a pH titration curve and estimation of strength of an acid
4. Estimation of acids in a mixture by conductometry
5. Potentiometric determination of Ferrous iron
6. Preparation and chemical etching of printed circuit boards
7. Determination of corrosion rate of steel in acid media by weight loss method
8. Determination of inhibitor efficiency on the corrosion rate of steel in acid media by weight loss method
9. Determination of total, permanent, Ca and Mg hardness of water.
10. Determination of conductivity, TDS, pH and alkalinity of water

### DEMO EXPERIMENTS:

1. Glass transition temperature of polymers- DSC curves and discussion
2. Determination of corrosion rate by polarization method and discussion of Tafel plots

### REFERENCES:

Laboratory Manual Prepared by Chemistry Department

## 08E213 CIRCUITS AND DEVICES LABORATORY

**0 0 3 1.5**

1. Verification of Ohm's and Kirchhoff's laws
2. Series and Parallel resonance circuits
3. Verification of Superposition theorem, Thevenin's theorem and Maximum power transfer theorem
4. Three phase power measurement by two wattmeter method.
5. Transient analysis of RLC circuit using PSPICE.
6. Characteristics of diode and clipper circuits.
7. Characteristics of Zener diode and Zener voltage regulator.
8. Characteristics of BJT.
9. Application of BJT as an amplifier and switch.
10. Characteristics of JFET and MOSFET.



**REFERENCES:**

1. Murugesh Kumar K, "Electrical Laboratory Exercise", Vikas Publishing House Pvt. Ltd., New Delhi 2003.
2. Poornachandra Rao S and Sasikala B, "Handbook of Experiments in Electronics and Communication Engineering", Vikas Publishing House Pvt. Ltd., New Delhi 2003.

**SEMESTER 3****08O301 TRANSFORMS AND COMPLEX ANALYSIS****3 2 0 4****TRANSFORM METHODS:** Concept of Transformation – Examples for Transformation. (2)**LAPLACE TRANSFORM:** Definition – Transforms of standard functions – Transform of unit step function – Dirac -Delta function- Transforms of derivatives and integrals – Transforms of Periodic functions – Inverse Laplace transform – Convolution theorem – Method of solving ordinary linear differential equations with constant coefficient by Laplace transform technique. Some applications to engineering problems. (10)**FOURIER TRANSFORM:** Fourier integrals – Fourier transform – Finite and infinite Fourier sine and Cosine transform – Transforms of standard functions – properties, Convolution theorem(Statement only) – Discrete Fourier and Fast Fourier Transforms – Discrete convolution – Periodic sequence and circular convolution – Discrete Fourier transform – decimation- in-time algorithm – Computation of inverse DFT. (10)**Z-TRANSFORM:** z- transform of standard functions, inverse Z-transform (Partial fraction expansions) – properties of Z – transform – Solution of difference equations. (8)**COMPLEX VARIABLES:** Analytic functions – Cauchy Reimann equations in Cartesian and polar – coordinates – Statement of sufficient conditions – properties of analytic functions – Finding analytic function whose real / imaginary part is given – conformal mapping , Bilinear map – study of mappings  $w = \exp(z)$ ,  $\sin z$ ,  $\cos z$ ,  $\sinh z$ ,  $\cosh z$ ,  $1/z$ ,  $z+k/z$  – Complex integration – Cauchy's fundamental theorem and formula- Taylor's series – Laurent's series (Statement only) – Singularities – Residue theorem – Cauchy's lemma and Jordan's Lemma (Statement only) – Evaluation of real integrals using contour integration along semi circle and unit circle. (12)**Total 42****REFERENCES:**

1. Erwin Kreyszig "Advanced Engineering Mathematics", John Wiley & Sons, 2001
2. Robert A Gabel, Richard A Roberts, "Signals and Linear systems", John Wiley & Sons, 1995.
3. Ray Wylie C, Louis C Barret, "Advanced Engineering Mathematics", McGraw-Hill, 2001
4. Riley K F, Hobson M P and Bence S J, "Mathematical Methods for Physics and Engineering", Cambridge University, 2004.

**08O302 ECONOMICS FOR BUSINESS DECISIONS****3 0 0 3****INTRODUCTION TO ECONOMICS:** Definitions – Scope and Significance of Economics in Decision Making – Various Economic Tools and Techniques. (2)**CALCULATING PERCENT CHANGE AND COMPOUNDED GROWTH RATES:** Some Mathematical Concepts and Analytical Tools. (3)**ECONOMIC THEORY OF CONSUMER DEMAND:** Law of Demand – Determinants of Demand – Exceptions to Law of Demand Elasticity of Demand – Various types of Elasticity and measurements of Price Elasticity and Demand Forecasting Methods and its Applications. Law of Supply – Elasticity of Supply – Determinants of Elasticity of Supply. (6)**ECONOMIC THEORY OF THE FIRM (Cont'd):** (Input Markets) – Production Function – Factors influencing Production – Cobb-Douglas Production Function – Economies of Scale – Returns to Scale – Cost Analysis - Various Cost Concepts - Cost Output Relationship and Short Run and Long Run. (6)**MARKET STRUCTURE AND COMPETITION:** Various Forms of Market Structure – Perfect Competition - Imperfect Competition – Monopoly – Monopolistic – Oligopoly – Pricing Strategies and Price Discrimination in various Market Structures. (4)**MARKET FAILURES AND GOVERNMENT INTERVENTION IN THE MARKET ECONOMY:** Basic Functions of Government – Market Efficiency – Tools of Government Intervention. (4)

**INTRODUCTION TO MACROECONOMICS:** (Measuring Aggregate Output) Meaning – Objective and Issues of Macroeconomics- National Output Concept – GDP, GNP, NNP, Per Capita Income, Disposable Income, Personal Disposable Income – Various Methods of Measuring National Income - Inflation – Deflation. (5)

**AGGREGATE EXPENDITURES AND FISCAL POLICY:** (Fiscal Policy) Objectives of Fiscal Policy – Instruments of Fiscal Policy – Taxation. Highlights of Current Fiscal Policy. (6)

**MONEY AND BANKING:** (Monetary Policy) Functions of Money - Value of Money - Objectives and instruments of Monetary Policy – Highlights of Current Monetary Policy – Banking – Types of Banks - Central Bank and Commercial Banks - Objectives and Functions of Central Bank and Various Types of Commercial Banks and Its Functions. (4)

**ECONOMIC GROWTH:** Meaning – Benefits and Costs of Growth. (2)

**Total : 42**

**TEXT BOOK:**

1. Paul A Samuelson and William D Nordhaus, “Economics”, Tata McGraw Hill, New Delhi, 2007.

**REFERENCES:**

1. Karl E Case and Ray C Fair, “Principles of Economics”, Prentice Hall, 2008.
2. Misra S K and Puri V K, “Economic Environment of Business”, Himalaya Publishing House, New Delhi, 2002.
1. Richard G Lipsey, Colin Harbury Weidenfeld and Nicolson, “Principles of Economics”, London, 1990.

## 08E303 DIGITAL ELECTRONICS

**2 2 0 3**

**NUMBER SYSTEMS AND BOOLEAN ALGEBRA:** Review of Number Systems – Number representation : Signed, Unsigned, Fixed point, Floating point. *Computer codes – BCD, Gray code, Excess 3 code, Error detection and correction codes, Parity, Hamming codes.* Boolean algebra – Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates. (4)

**DIGITAL LOGIC FAMILIES:** Characteristics of digital ICs – Voltage and current ratings, Noise margin, Propagation delay, Power dissipation. TTL logic family – Totem pole, Open collector and tristate outputs, Wired output operations, LS, ALS and Fast sub families. MOS transistor switches –nMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. Multiplexers – High speed CMOS (74HC, 74HCT, 74AHC, 74AHCT logic sub-families) and ECL logic families – *Comparison of performance of various logic families. Interfacing TTL and CMOS devices.* (6)

**COMBINATIONAL LOGIC DESIGN:** Standard representation of logic functions – Incompletely specified functions, Simplification of logic functions through K – maps and Quine-McClusky method, Implementation using logic gates. Decoders, Encoders, Multiplexers and Demultiplexers. Implementation of Combinational circuits using Multiplexers and Demultiplexers.

**ARITHMETIC CIRCUITS:** *Binary / BCD adders and subtractors, Carry look ahead adder, Magnitude comparator, ALU.* (8)

**INTRODUCTION TO SEQUENTIAL DEVICES:** General model of sequential circuits – Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration. Binary counters, Shift register, Ring counter, Johnson counter, Timing diagram. (6)

**DESIGN OF SEQUENTIAL CIRCUIT:** Mealy/Moore models – Concept of state, State diagram, State table, State reduction procedures using Partitioning and Implication chart. Minimal flip flop / one-hot realization. Design of synchronous sequential circuits – Up-down / Modulus counters, Serial adder, Parity checker, Sequence detector. Introduction to Asynchronous Sequential Circuits – Fundamental mode and Pulse mode circuits. (6)

**PROGRAMMABLE LOGIC DEVICES:** Semicustom design. Introduction to PLDs – ROM, PAL, PLA, FPLA, FPLS. Architecture of PLDs – PAL 22V10, *PLS 100/101*, Implementation of digital functions. (5)

**VHDL:** Digital design process flow- Software tools-Hardware Description Language – VHDL – Data Objects-Operators-Entities and Architecture – Component declaration - Component instantiation – Concurrent statements-Sequential statements-Behavioral, Dataflow and Structural modeling-Simple VHDL codes. (7)

**Total 42**

**TEXT BOOKS:**

1. Tocci R J, Widmer N S and Moss G L, “Digital Systems: Principles and applications” , Ninth Edition, Pearson Education (Singapore) Pvt. Ltd, 2007.
2. Donald Givone, “Digital Principles and Design”, Tata Mc Graw – Hill Edition, 2002.
3. Roth C H, “Digital Systems Design using VHDL,” Thomson Asia, 2006.

**REFERENCES:**

1. Nelson V P, Nagle H T, Carroll B D, and Irwin J D, “Digital Logic Circuit Analysis and Design”, Prentice Hall International Inc., New Jersey, 1996.
2. Leach D P, Malvino A P and Goutam Saha, “Digital Principles and Applications”, Tata Mc Graw – Hill, Sixth Edition, 2006

3. Norman Balabanian and Bradley Carlson, "Digital Logic Design Principles", John Wiley & Sons, Singapore, 2002.
4. Anand Kumar, "Fundamentals of Digital Circuits" Prentice Hall of India, Pvt Ltd, New Delhi, 2004.
5. Bhasker J, "A VHDL Primer", Third Edition, Prentice Hall of India, 2006.

### 08E304 MECHANICS FOR ELECTRICAL ENGINEERS

2 0 0 2

**STRUCTURAL ANALYSIS:** Equilibrium of concurrent and coplanar forces – Forces in pinjointed plane frames and trusses – Cable having supports at different levels – Calculation of Sag. Length of cable and tension. (7)

**SFD/BMD:** Bending moment and shear force diagrams in simply supported, overhanging and cantilevers subjected to concentrated loads and UDL. (7)

**AXIAL BENDING STRESSES:** Stresses and strains – Hooke's Law – Stresses and Strain in stepped bars – Concept of flexural stress qualitative aspect only – Flexure formula and design of rectangular beam section. (7)

**TORSION:** Concept of torsion and torsional shear stress – Torsion formula and design of circular shaft – Power transmitted section to carry torque. (7)

Total 28

**TEXT BOOKS:**

1. Bansal R K, "Engineering Mechanics", Laxmi Publications (P) Ltd., New Delhi, 2006.
2. Ramamrutham S and Narayan R, "Strength of Materials", Dhanpat Rai and Sons, New Delhi, 1997.

**REFERENCE:**

1. Khurmi R S, "Applied Mechanics and Strength of Materials", Kav Nirja Construction and Development Co. P. Ltd., 1992.

### 08E305 ELECTRONIC CIRCUITS

3 1 0 3.5

**POWER SUPPLIES:** Rectifiers – Half wave and Full wave rectifiers, Average and RMS value, Ripple factor, Regulation, Rectification efficiency, Transformer Utility Factor. Filters – Inductor, Capacitor, L type and  $\Pi$  type, Ripple Factor and Regulation. Need for voltage regulators – Series and Shunt regulators, Comparison, Current limiting and protection circuits – introduction to Switched mode power supplies (8)

**WAVE SHAPING:** Response of High pass and Low pass RC circuit for sinusoidal, step, pulse, square, ramp and exponential inputs. Linear wave shaping–Integrator, Differentiator. Non-linear wave shaping–Clipping and clamping circuits, clamping circuit theorem and applications, Attenuator and compensated attenuator. Introduction to pulse transformers and applications. (8)

**VOLTAGE AMPLIFIERS:** BJT and JFET amplifiers – RC coupled amplifiers, Cascaded BJT amplifiers, Analysis at low, medium and high frequencies. BIFET amplifiers. DC amplifiers – Problems in DC Amplifiers, Differential and Common mode gain, CMRR. Cascode and Darlington Amplifiers. Chopper Amplifiers. (8)

**POWER AMPLIFIERS AND FEEDBACK AMPLIFIERS:** Power amplifiers– Classification, Class A/B/C, Single ended and Push-pull Configuration, Power dissipation and output power, Conversion efficiency, Complementary symmetry power amplifiers, Class AB operation. Basic concepts of feedback amplifiers – Effect of negative feedback on input and output resistances, gain, gain stability, distortion and bandwidth. Voltage and current feedback circuits. (9)

**OSCILLATORS AND MULTIVIBRATORS:** Oscillators – Barkhausen criteria, RC and LC oscillators using BJT – RC phase shift, Wien bridge oscillators, Hartley and Colpitt's oscillators. Frequency stability of oscillators. Crystal oscillators. Non-sinusoidal oscillators – Multivibrators – Bistable, Monostable, Astable multivibrators and Schmitt Trigger using BJT. (9)

Total 42

**TEXT BOOKS:**

1. Millman J and Halkias C, "Electronic Devices & Circuits", Tata McGraw-Hill, New Delhi, Twenty seventh Reprint, 2002.
2. Millman J and Grabel A, "Microelectronics", Second edition, Tata McGraw-Hill, New Delhi, 1999.
3. Millman J and Taub H, Mothiki S Prakash Rao, "Pulse, Digital and Switching waveforms", Tata McGraw-Hill, New Delhi Second Edition, 2007.

**REFERENCES:**

1. David A Bell, "Electronic Devices and Circuits", Oxford university press, , FifthEdition, 2007.
2. Boylestad R L and Nashelsky L, "Electronic Devices and Circuit Theory", Pearson Education India, New Delhi, Ninth Edition 2005 / Prentice Hall of India.
3. Floyd, "Electronic Devices," Pearson Education India, New Delhi,Eighth Edition, 2003. / Prentice Hall of India
4. Bogart, "Electronic Devices & Circuits", Prentice Hall of India, Sixth Edition, 2003.

## 08E306 DC MACHINES AND TRANSFORMERS

3 0 0 3

**DC GENERATORS:** Laws of magnetic circuit – Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation, Separate, shunt, series and compound excitations. (5)

No load characteristics – Armature reaction, Commutation, Interpoles, Compensating windings, Load characteristics of various types of DC Generators. (6)

**DC MOTORS:** Principle of operation – Torque equation, Electrical and Mechanical characteristics of DC shunt, series and compound motors. Starters – Speed control – Armature and field control – Braking. (6)

Losses and efficiency – Swinburne's test – Separation of losses, Hopkinson's test. (5)

**TRANSFORMERS:** Principle of operation – Constructional features, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no-load and load, Phasor diagrams. (5)

Equivalent circuit - Voltage regulation, Regulation curve, Losses, Efficiency, All day efficiency (5)

Phasing out, polarity and voltage ratio tests – Open circuit and short circuit tests, Sumpner's test. Separation of losses – Parallel operation (5)

Auto-Transformer – Principle of operation – Saving of copper – Phasor diagram – Equivalent circuit – Three phase Transformer connections – Instrument Transformers. (5)

**Total 42**

### TEXT BOOKS:

1. Murugesh Kumar K, "DC Machines & Transformers", Vikas Publishing House Pvt Ltd., Second Edition, 2004.
2. Clayton A E and Hancock N N, "The Performance and Design of DC Machines", Oxford and IBH Publishing Co. Pvt. Ltd., 1987.

### REFERENCES:

1. Cotton H, "Advanced Electrical Technology", A H Wheeler and Company Publications, London, 1990.
2. Gupta B R and Vandana Singhal, "Fundamentals of Electrical Machines", New Age Inter National Publishers, 1996.
3. Sen P C, "Principles of Electrical Machines and Power Electronics" John Wiley & Sons, Inc. Singapore, Second Edition, 1997.

## 08E307 ELECTROMAGNETIC FIELDS

3 0 0 3

**INTRODUCTION:** Review of Vector algebra. Coordinate Systems – Gradient, Divergence, and Curl Operators- Line, Surface and Volume integrals. (4)

**ELECTROSTATIC FIELDS:** Coulomb's law – Electric field intensity, Determination of field due to point charge, line, surface and volume charge distributions, Electric flux density: Gauss's law – Applications of Gauss's law. Divergence theorem. Potential :Absolute potential – Potential difference, Potential calculation for different charge configurations, Potential Gradient- Electric Dipole.-Energy density in electrostatic field. (10)

**ELECTRIC FIELDS IN MATERIAL SPACE:** Properties of materials-convection and conduction currents -conductors – polarization in dielectrics- dielectric constant and strength - continuity equation and relaxation time- Boundary conditions involving conductors, dielectric, and free space. (5)

**ELECTROSTATIC BOUNDARY-VALUE PROBLEMS:** Poisson's and Laplace's equations-uniqueness theorem- Solution of Laplace's equation of single variable only- resistance and capacitance determination-method of images. (5)

**MAGNETOSTATIC FIELDS:** Biot Savart's law - Ampere's circuital law –Stokes' theorem, Magnetic flux density, Scalar and Vector magnetic potentials-Maxwell's equations for static EM fields. (5)

**MAGNETIC FORCE:** Forces due to magnetic fields-magnetic torque and moment-Force and Torque on a closed circuit-Magnetic Materials- Boundary conditions at the interface of two different magnetic materials. (5)

**INDUCTANCE:** Self and mutual inductance – Inductance of Solenoid, Toroid , Coaxial cable and Transmission line. Energy density in magnetic field. Lifting force of a magnet. (4)

**TIME VARYING FIELD:** Faraday's Law – transformer and motional emfs- Displacement Current- Maxwell's Equations in final form-EM wave: Power and Poynting theorem. (4)

**Total 42**

### TEXT BOOKS:

1. Matthew N O Sadiku, "Elements of Electromagnetics", Oxford University Press, Third Edition, 2005.
2. William H Hayt Jr., John A Buck, 'Engineering Electromagnetics', Tata McGraw Hill edition, New Delhi, Third Edition, 2007.

**REFERENCES:**

1. Joseph A Edminister, 'Theory and Problems of Electromagnetics', Second edition, Schaum's Outline Series, Tata McGraw Hill, New Delhi, 2005.
2. Gangadhar K A, "Field Theory", Khanna Publishers, Fifteenth Edition, Third Reprint 2004.

**08E310 ELECTRONIC CIRCUITS AND DIGITAL LABORATORY****0 0 3 1.5**

1. Response of low pass and high pass RC circuits for pulse and square input signals
2. Design of series voltage regulator
3. Design of RC coupled amplifier
4. Design of Class B Push Pull amplifier
5. Design of Oscillators.
6. Study of Basic Digital ICs and Implementation of Adder and Subtractor circuits
7. Design of Code converters.
8. Design and Implementation of Counters and registers using suitable ICs
9. Study of Multiplexer and Demultiplexer.
10. Design of Synchronous sequential circuit.

**REFERENCES:**

Laboratory Manual, Prepared by EEE Department

**08E311 DC MACHINES AND TRANSFORMERS LABORATORY****0 0 3 1.5**

1. Load Characteristics of DC Shunt and Compound Generator.
2. Load Characteristics of DC Shunt and Compound Motor.
3. Load Test on DC series motor
4. Hopkinson's Test.
5. Sumpner's Test.
6. Electrical Braking of DC Shunt motor.
7. Load Test on 1-Phase Transformer.
8. Open circuit and Short circuit Tests on 1 Phase transformer
9. Sumpner's Test on a single Phase Transformer.
10. Phase relation test of a three phase transformer

**REFERENCES:**

Murugesh Kumar K, "Electrical Laboratory Exercise", Vikas Publishing House Pvt. Ltd., New Delhi 2003

**SEMESTER 4****08E401 LINEAR INTEGRATED CIRCUITS****2 2 0 3**

**OPERATIONAL AMPLIFIER CHARACTERISTICS:** Functional Block Diagram – Symbol, Characteristics of an ideal operational amplifier, Circuit schematic of  $\mu A 741$ , Open loop gain, CMRR-input bias and offset currents, input and output offset voltages, offset compensation techniques. Frequency response characteristics – stability, limitations, frequency compensation, slew rate. Transfer characteristics. (6)

**LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS:** Inverting and Non-inverting amplifiers – Voltage follower, Summing amplifier, Differential amplifier, Instrumentation amplifier. Integrator and Differentiator – Practical considerations. Voltage to Current and Current to Voltage converters, Phase changers. Sinusoidal oscillators. Active filters – Design of low pass, high pass, wide band pass and Band stop Butterworth filters, Narrow band pass and notch filters. (7)

**NON LINEAR APPLICATIONS OF OPERATIONAL AMPLIFIERS:** Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Precision diode, *Half and Full wave rectifiers*, Active peak detector, Clipper and Clamper, Logarithmic and Exponential amplifiers, *Multiplier and Divider*, Square and Triangular waveform generators. (6)

**SINGLE POWER SUPPLY OPERATIONAL AMPLIFIERS:** Need for single power supply operational amplifiers – LM324, AC Inverting and Non-Inverting amplifiers. Norton Amplifiers – *Various configurations*. (2)

**IC VOLTAGE REGULATORS:** Block diagram of 723 general purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting, Fixed and adjustable three terminal regulators, *Switching regulators*. (6)

**SPECIAL FUNCTION ICs:** 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator, Analog Multiplier, Comparator ICs. PLL Functional Block diagram – Principle of

operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications: Frequency synthesis, AM and FM detection, FSK demodulator, *Motor speed control*. (8)

**A-D and D-A CONVERTERS:** DAC/ADC performance characteristics – Digital to Analog Converters: Binary weighted and R-2R Ladder types – Analog to digital converters: Continuous, Counter ramp, Successive approximation, Single slope, Dual slope and *Parallel types* (7)

**Total 42**

**TEXT BOOKS:**

1. Sedra and Smith, "Microelectronic Circuits", Oxford University Press, Fifth Edition, 2004.
2. Gayakwad A R, "OP-Amps and Linear Integrated circuits", Pearson Education, New Delhi, Fourth Edition, 2004  
Prentice Hall of India, New Delhi.

**REFERENCES:**

1. Coughlin F R, and Driscoll F F, "Operational Amplifiers and Linear Integrated Circuits", Prentice Hall of India, Fourth edition, New Delhi, 1997. / Pearson Education, New Delhi.
2. Roy Choudhury and Shail Jain, "Linear Integrated Circuits", New Age International Limited, Second Edition, 2003
3. Michael Jacob J, "Applications and design with Analog Integrated Circuits", Prentice Hall of India, New Delhi, Second Edition, 1996.
4. David A Bell, "Operational Amplifiers and Linear Ics", Prentice Hall of India, Second Edition, 1997.

## 08E402 PRINCIPLES OF COMMUNICATION ENGINEERING

**2 0 0 2**

**AM SYSTEM:** Introduction - Amplitude modulation theory - Frequency Spectrum - Representation - Power relation - AM Generation – Class C power Amplifier – Evolution & description of SSB – Balanced Modulator – Advantages of SSB Transmission - AM transmitter – AM receiver - AM envelope detector – Superhetrodyne receiver. (6)

**FM SYSTEM:** Frequency Modulation - Phase Modulation – Armstrong Method of FM Generation – Ratio Detector – FM Transmitter - FM broadcast Receiver - Comparison of Wideband And Narrow Band FM. (6)

**DIGITAL COMMUNICATION SYSTEM:** Advantages of Digital Data transmission – Sampling – Pulse Code Modulation – Channel coding – Line coding – Digital Modulation schemes: ASK, FSK, QPSK – Digital Communication Receiver – Synchronisation. (6)

**FIBRE OPTIC SYSTEM:** History of fibre optics-optical fibres versus metallic cables-optical fibre communication system-light propagation through optical fibres-fibre configurations-acceptance angle and acceptance cone-losses in optical fibre cables, light sources, light detectors, lasers. (5)

**ADVANCED COMMUNICATION SYSTEMS:** Introduction to cellular radio telephones, Wireless Access methods, Wireless LAN – Introduction to ISDN and BISDN. (5)

**Total 28**

**TEXT BOOKS:**

1. Kennedy G, "Electronic Communication systems", McGraw Hill Inc., Fifth edition, 1992.
2. Wayne Tomasi, "Advanced Electronic Communication Systems", Sixth edition, Pearson Education, 2004.
3. Keiser, "Optical Fibre Communications", McGraw Hill, 1983.
4. Theodore S Rappaport, "Wireless Communication" Pearson Education Asia, New Delhi, Second Edition, 2002

**REFERENCES:**

1. Lathi B P "Modern digital and analog communication systems", Oxford series in Electrical and Computer Engineering, 1998.
2. Taub and Schilling, "Principles of communication systems" McGraw Hill International edition, Seventh Reprint, New Delhi, 1996.
3. Simon Haykin, "Communication Systems", Fourth edition, Wiley Publications, Singapore, 2008.

## 08E403 MEASUREMENTS AND INSTRUMENTATION

**3 0 0 3**

**STANDARDS AND INDICATING INSTRUMENTS:** SI units – units for charge, voltage, current, power, energy, flux. Standards – brief Introduction. D'Arsonval Galvanometer. Moving iron: attraction and repulsion type instruments, errors. Moving coil instruments – Permanent magnet moving coil instruments, Dynamometer type moving coil Instruments, Torque equations and errors. Extension of ranges, use of shunts and Instrument Transformers. (10)

**MEASUREMENT OF POWER AND ENERGY:** Dynamometer type wattmeter – Torque expression, Errors. Energy meters, Calibration of energy meters. Measurement of power using Instrument Transformers. Maximum demand indicator, Power factor meter. (7)

**MEASUREMENT OF R-L-C:** Resistance measurement – Kelvin double bridge, Wheatstone bridge, substitution method, Loss of charge method, Guard Wire method. Measurement of inductance and capacitance – Maxwell, Anderson, Hay's and Schering bridges. Measurement of Earth resistance. (7)

**MEASUREMENT OF NON-ELECTRICAL QUANTITIES:** Transducers – Classifications, Principle of operation of Resistance potentiometer, Inductive and capacitive transducers, LVDT, Strain Gauge and Piezo-electric transducers. Encoders. Hall effect sensors and photo sensors. Measurement of Pressure – High Pressure and low pressure measurement. Measurement of Temperature - Resistance thermometers, thermistors and thermocouples. Speed measurement- contact and non-contact type. (10)

**ELECTRONIC LABORATORY INSTRUMENTS:** Electronic voltmeter – Digital voltmeter of ramp and integrating types. Digital Multimeter – block diagram. Block diagram of dual channel oscilloscope. Spectrum Analyzer. Pulse, signal and function generators. Harmonic distortion analyzer. Strip chart and X-Y recorders, Field Bus Instrumentation. (8)

**Total 42**

**TEXT BOOK:**

1. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Rai & Sons, New Delhi, Eighteenth edition, 2001.

**REFERENCES:**

1. Helfrick D Albert, and Cooper W D, "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India Limited, New Delhi, 1992.
2. Doebelin E, "Measurement Systems : Application And Design", Fifth Edition, Tata Mc-Graw Hill Book Co., New Delhi, 2004.
3. Golding E W, and Widdis F C, "Electrical Measurements and Measuring Instruments", A H Wheeler & Company, Calcutta, Fifth edition, 2003.
4. Rangan C S, Sharma G R, Mani V S, 'Instrumentation Devices and Systems', Second Edition, Tata McGraw Hill, New

## 08E404 C++ AND DATA STRUCTURES

**3 1 2 4.5**

**PRINCIPLES OF OBJECT ORIENTED PROGRAMMING:** Software crisis Software Evolution - Procedure Oriented Programming - Object Oriented Programming paradigm - Basic concepts and benefits of OOP - Object Oriented Language - Application of OOP - Structure of C++ - Applications of C++ - Tokens, Expressions and Control Structures - Operators in C++ - Manipulators. (4)

**FUNCTIONS IN C++:** Function Prototyping - Call by Reference - Return by reference - Inline functions - Default, Const Arguments - Function - Overloading - Friend and Virtual Functions - Classes and Objects - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static Member Functions - Arrays of Objects - Objects as Function - Arguments - Friendly Functions - Returning Objects - Const Member functions - Pointers to Members. (8)

**CONSTRUCTORS:** Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors – Destructors overloading - Overloading Unary and Binary Operators - Overloading Binary Operators using Friend functions. (5)

**INHERITANCE:** Defining Derived Classes - Single Inheritance - Making a Private Member Inheritable - Multiple Inheritance - Hierarchical Inheritance - Hybrid Inheritance - Virtual Base Classes - Abstract Classes - Constructors in Derived Classes - Member Classes - Nesting of Classes. (5)

**DATA STRUCTURES:** Abstract data Types - Primitive data structures - Analysis of algorithms - Best, worst and average case time complexities - Notation. (3)

**ARRAYS:** Operations - Implementation of one, two, three and multi dimensioned arrays – Sparse and dense matrices - Applications. (3)

**STACKS:** primitive operations - Sequential implementation - Applications: Subroutine handling - Recursion. (4)

**QUEUES:** Primitive operations - Sequential implementation - Dequeues - Applications: Image component labeling; Machine shop simulation. (4)

**LISTS:** Primitive Operations - Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists - Applications Addition of Polynomials; Sparse Matrix representation and Operations. – Linked Stacks - Linked queues. (6)

**Total 42**

**TEXT BOOKS:**

1. Bjarne Stroustrup, "The C++ Programming Language", Pearson Education, 2001.
2. Stanley B Lippman and Josee Lajoie, "The C++ Primer", Pearson Education, 2001.
3. Yedidyah Langsam, Moshe J Augenstein and Aaron M Tenenbaum, " Data Structures Using C and C++ ", Prentice Hall of India, 2001.

**REFERENCES:**

1. Horowitz, Sahni and Meheta D, "Fundamentals of Data Structures in C++", Computer science press, 1995.
2. Deital and Deital, "C++ How to program", Prentice Hall, 2001.
3. Ganesh S G, "60 tips on Object Oriented Programming", Tata McGraw-Hill, New Delhi, 2008.

**08E405 INDUCTION AND SYNCHRONOUS MACHINES****3 1 0 3.5**

**THREE-PHASE INDUCTION MOTORS:** Principle of operation – Types of construction – Torque equation – Torque-Slip characteristics – Maximum torque – Effect of rotor resistance. (5)

Equivalent circuit – Phasor diagram – Performance calculation from circle diagram - Induction Generators – Testing. (6)

Automatic Starters – DOL, Auto-Transformer, Star-Delta and Rotor resistance starters – Speed control – Crawling and Cogging – Electrical Braking. (5)

**SINGLE-PHASE INDUCTION MOTORS:** Principle of operation – Double revolving field theory – Equivalent circuit – Performance calculations – Methods of self starting. (4)

**SYNCHRONOUS GENERATORS:** Types - Constructional features – 3-phase windings – Winding factors – EMF equation – Armature reaction – Voltage regulation – Predetermination of regulation by synchronous impedance, mmf, and Potier reactance methods. (6)

Load characteristics – Power expression – Parallel operation – Synchronising and synchronising power – Active and reactive power sharing – Alternator on infinite Busbar – General load diagram. (6)

**SYNCHRONOUS MOTORS:** Principle of operation – Methods of starting – Phasor diagrams – V-curves and Inverted V-curves - Power/Power-angle relations – Synchronous condensers – Hunting and methods of Suppression. (5)

**TWO REACTION THEORY:** Salient pole machine analysis – Phasor diagrams – Voltage regulation – Power / Power angle relation – Determination of  $X_d$  and  $X_q$ . (5)

**Total 42****TEXT BOOKS:**

1. Murugesh Kumar K, "Induction & Synchronous Machines", Vikas Publishing House Ltd, 2000
2. Say M G, "Alternating Current Machines", Fifth Edition, Pitman, 1990.

**REFERENCES:**

1. Alexander S Langsdorf, "Theory of Alternating Current Machinery", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1990.
2. Gupta B R, and Vandana Singhal, "Fundamentals of Electric Machines", New Age International Publishers, New Delhi, 1996.

**08E410 LINEAR ICs AND MEASUREMENTS LABORATORY****0 0 3 1.5**

1. Characteristics and Applications of Op Amp (CMRR, Slew, Rate, Adder, Subtractor, Zero crossing detector, Differentiator, Integrator)
2. Waveform Generation using OpAmp (Square, Rectangular, Triangular and Sinusoidal)
3. Performance characteristics of Voltage Regulator ICs
4. Study of 555 Timer and 566 VCO
5. Design and Implementation of Active Filters.
6. Three Phase power measurement by two wattmeter method
7. Extension of instrument ranges
8. Calibration of Energy meter using Phantom loading method.
9. Linear variable differential transformer and strain gauge
10. Wheatstone bridge and Kelvin's Double Bridge.

**REFERENCES:**

Laboratory Manual, Prepared by EEE Department

**08E411 AC MACHINES LABORATORY****0 0 3 1.5**

1. Load Test on 3 -Phase Induction Motor
2. No load Test and Blocked Rotor Test on 3- Phase Induction Motor.
3. Electrical Braking of 3 -Phase Induction Motor
4. Load Test on 1- Phase Induction Motor
5. Regulation of Alternator by Synchronous Impedance and MMF Methods.
6. Regulation of Alternator by ZPF Method



7. Regulation of Alternator by Bus bar Loading
8. V and Inverted V Curve of Synchronous Motor
9. Load test on 3 - Phase Induction Generator
10. Regulation of Salient Pole Alternator by Blondel's Method

**REFERENCES:**

Murugesh Kumar K, "Electrical Laboratory Exercise", Vikas Publishing House Pvt. Ltd., New Delhi 2003

## SEMESTER 5

### 08E501 ENVIRONMENTAL SCIENCE AND ENGINEERING

( Also Common with 08L601/ 08Z601/ 08I601/ 08D701/08M701/ 08P701/ 08Y701/ 08T701/ 08A701/ 08B701)

**3 0 0 3**

**NATURAL RESOURCES, ECOSYSTEMS AND BIODIVERSITY:** Environment - Definition, scope and importance – Forest resources: Use and overexploitation, Water resources: Use and over-utilization, dams-benefits and problems – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.– Land resources: land degradation – Role of an individual in conservation of natural resources Ecosystem – Structure and function – Ecological succession – Introduction to various ecosystems. Biodiversity – Definition and types – Threats to Biodiversity in India and its impacts – Conservation of Biodiversity. – Wildlife Protection Act - Forest Conservation Act. (9)

**AIR POLLUTION AND CONTROL:** Introduction – atmospheric constituents – Chemical reaction in the atmosphere – air pollutants – classification – effects on human, animal, plant, property and environment – control methods for particulates and gaseous pollutants – control of pollutants from automobiles – Global Environmental Issues – Climate change, global warming, acid rain, ozone layer depletion and solutions – Burning of plastics – PCBs and their impact. (8)

**WATER POLLUTION AND CONTROL:** Sources – characteristics – BOD, COD - pollutants and their effects – heavy metal pollution – inorganic and organic pollutants control methods – screening, sedimentation, biological processes - working and design principles – advanced waste water treatment techniques - self purification of rivers – Eutrophication of lakes – sludge management. (8)

**OTHER ENVIRONMENTAL POLLUTIONS:** Definition – Causes, effects and control measures of: Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste management: causes, effects and control measures of urban and industrial solid wastes - Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water Act – Introduction to EIA and ISO 14000 (8)

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management - Population growth, variation among nations – Population explosion - Environment and human health – Role of Information Technology in Environment and human health - Disaster management: floods, earthquake, cyclone and landslides. (9)

**Total 42**

**TEXT BOOKS:**

1. Deswal S and Deswal A, "A Basic course in Environmental studies", Dhanpat Rai & Co, First Edition, Delhi, 2004
2. Kurian Joseph and Nagendran R, "Essentials of Environmental studies", Pearson Education Pvt Ltd., First Edition, Delhi, 2004
3. Santhosh Kumar Garg, Rajeswari Garg and Ranjani Garg, "Environmental Science and Ecological Studies", Khanna Publishers, Second Edition, New Delhi, 2007.

**REFERENCES:**

1. Gilbert M Masters, "Introduction to Environmental Engineering and Science", Pearson Education Pvt. Ltd., Second Edition, 2004.
2. Tivedi R K, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 1998
3. Cunningham, Cooper W P and Gorhani T H, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
4. Wager K D, "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.

### 08E502 CONTROL SYSTEMS

**3 1 0 3.5**

**INTRODUCTION:** Open loop and closed loop systems – Examples, Control system components. (2)

**SYSTEM REPRESENTATION:** Transfer function of physical systems– Mechanical systems, Translational and Rotational systems, Electrical network, Thermal and hydraulic systems. Transfer function of DC Generator, DC servomotor, AC servomotor and Synchro, Transfer function of overall systems. Impulse Transfer function. Block diagram - reduction techniques. Signal flow graphs – Mason' gain formula. (8)

**TIME RESPONSE ANALYSIS:** Standard Test signals – Time response of zero, first and second order system, Performance criteria, Type of systems. Steady state error constants – position, velocity and acceleration error constants. Generalized error series – Feedback characteristics of control systems. Controllers – P, PI and PID control modes. (8)

**FREQUENCY RESPONSE ANALYSIS:** Frequency domain specifications – peak resonance, resonant frequency, bandwidth and cut-off rate, correlation between time and frequency responses for second order systems. Polar plot, Bode plot – Gain Margin and Phase Margin. (6)

**STABILITY OF SYSTEMS:** Characteristic equation – Location of roots of characteristic equation – Absolute stability and Relative stability. Routh Hurwitz criterion of stability – Necessary and sufficient conditions. Nyquist Stability- Principle of argument – Nyquist path – Nyquist stability criterion – Determination of Nyquist stability – Assessment of relative stability. Bode Plot – Assessment of stability, Nichols Chart. (8)

**COMPENSATOR DESIGN:** Lag, Lead and Lag-Lead Compensator design using frequency response method. (3)

**ROOT LOCUS:** Root locus concept, Rules for construction of root loci, problems, stability analysis. (4)

**STATE VARIABLE ANALYSIS:** Introduction to state space analysis – Physical variable, Phase variable and Canonical variables forms. Transfer function from state space representation. (3)

**Total 42**

**TEXT BOOKS:**

1. Gopal M, "Control Systems – Principles and Design" Tata McGraw-Hill Co. Ltd., New Delhi, 2002.
2. Ogata K, "Modern Control Engineering", Fourth Edition, Pearson/Prentice-Hall Of India Pvt Ltd., New Delhi, 2002

**REFERENCES:**

1. Nagrath I J and Gopal M, "Control System Engg", Fifth Edition, New Age International publishers, 2007
2. Benjamin C Kuo, "Automatic Control Systems" Eighth edition, John wiley & sons, inc., 2003.
3. Norman S Nise, "Control System Engineering ", Fifth edition, John wiley & sons, inc., 2007.

## **08E503 MICROPROCESSORS AND MICROCONTROLLERS**

**3 1 0 3.5**

**ARCHITECTURE OF 8085 MICROPROCESSOR:** Functional Block Diagram – Registers, ALU, Bus systems – Timing and control signals. (4)

**PROGRAMMING OF 8085:** Instruction formats – Addressing modes – Instruction set – Need for Assembly language – Development of Assembly language programs – Machine cycles and Timing diagrams (6)

**MEMORY INTERFACING:** Interface requirements – Address space partitioning – Buffering of Buses – Timing constraints – Memory control signals – Read and write cycles – Typical EPROM and RAM Interfacing. (4)

**I/O INTERFACING:** Memory mapped I/O scheme – I/O mapped I/O scheme – Input and Output cycles – Simple I/O ports – Programmable peripheral interface (8255). Data transfer schemes – Interfacing simple keyboards and LED displays. (6)

**INTERRUPTS AND DMA:** Interrupt feature – Need for interrupts - Characteristics of Interrupts – Types of Interrupts – Interrupt structure – Methods of servicing interrupts - Development of Interrupt service subroutines – Multiple interrupt requests and their handling – Need for Direct Memory Access – Devices for handling DMA – Typical DMA Controller features. (6)

**APPLICATIONS:** Multiplexed seven segment LED Display systems – Stepper motor control – Measurement of frequency, phase angle and power factor – Interfacing ADC0801 A/D Converter – DAC 0800 D/A Converter – Waveform generators. (5)

**INTEL 8051 MICROCONTROLLER:** Architecture – Memory Organisation – Addressing modes – Instruction set – Boolean processing – Simple programs. (5)

**8051 PERIPHERALS:** Interrupt structure – Timer, Serial ports and Power control : Features and Modes – Interfacing – Instruction set – Boolean processing – Simple programs – Typical Applications – MCS 51 family features 8031/ 8051/ 8751. (6)

**Total 42**

**TEXT BOOKS:**

1. Ramesh S Goankar, "Microprocessor Architecture: Programming and Applications with the 8085 ", Fourth edition, Penram International, 2000.
2. Mazidi Muhammed Ali, Mazidi Janice Gillispie, "The 8051 Microcontroller and Embedded Systems", Pearson Education India, 2000.

**REFERENCES:**

1. Kenneth L Short, "Microprocessors and Programmed Logic, Pearson Education/PHI, New Delhi, Second Indian Reprint, 2004.
2. The MCS – 80 / 85 Family User's Manual, INTEL.
3. "8-bit Embedded Controllers", User's Manual, Intel Corporation, 1990.

## 08E504 POWER ELECTRONICS

3 0 0 3

**POWER SEMICONDUCTOR DEVICES:** Introduction - Power Diodes - Power Transistors - Power MOSFETs - IGBTs - Thyristor family : SCRs, Triacs, GTOs, MCT and IGCT - Static and Dynamic characteristics - Protection circuits - Series and parallel connections. (6)

**AC TO DC CONVERTERS:** Diode rectifiers: single phase and three phase diode bridge rectifiers with R, RL and RLE load - Estimation of average load voltage and average load current - Free wheeling diode, Controlled rectifiers: Single phase and three phase half wave Thyristor converters. Estimation of average load voltage and average load current. Single phase half controlled and fully controlled Thyristor bridge converters - Estimation of average load voltage and load current for continuous current operation - Input power factor estimation for ripple free load current - Three phase half and fully controlled Thyristor converters (no analysis) - Dual converters. (8)

**AC TO AC CONVERTERS:** Single phase full wave controller with R and RL load - Estimation of RMS load voltage, RMS load current and input power factor - Three phase AC voltage controllers (No analysis) - Single phase to single phase cycloconverters. (6)

**DC TO DC CONVERTERS:** Principle of step up and step down operation - Single quadrant DC chopper with R, RL and RLE load - Time ratio control - Estimation of average load voltage and load current for continuous current operation - Two quadrant and four quadrant DC choppers. (5)

**DC TO AC CONVERTERS:** Types - Voltage source and current source inverters - Single phase bridge inverters - Three phase bridge inverters - Control of AC output voltage - Harmonic reduction – Single phase series inverters. (5)

**CONTROL CIRCUITS:** Functional requirements of the switching control circuits - Generation of control signals for single phase AC to DC converters - Cosine wave crossing control, ramp comparator approach. Generation of timing pulses for DC choppers - PWM techniques for DC to AC converters - Introduction to power converter control using microprocessors, microcontrollers and DSP. (6)

**APPLICATIONS:** UPS – Selection of UPS – battery charging circuit-SMPS- HVDC systems - Tap changing of Transformers. (6)

Total 42

### TEXT BOOKS:

1. Rashid M H, "Power Electronics – Circuits, Devices and Applications", Pearson Education (Singapore) Pte. Ltd, New Delhi / Prentice Hall of India, New Delhi, 2004.
2. Ned Mohan, Undeland and Robbins, "Power Electronics - Converters, Applications and Design", John Wiley & sons, Singapore, 2003
3. Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, New Delhi, 1996.

### REFERENCES:

1. Philip T Krein, "Elements of Power Electronics", Oxford University Press, Inc., New York, 2003.
2. Joseph Vithayathil, "Power Electronics", Mc-Graw Hill series in Electrical and Computer Engineering, USA, 1995.

## 08E505 COMPUTER ARCHITECTURE

2 2 0 3

**INTRODUCTION:** Register transfer language-register, bus and memory transfers–Arithmetic, logic and shift micro operations. (5)

**BASIC COMPUTER ORGANISATION:** Instruction codes – Instructions – Timing and Control – Instruction Cycle – Fetch and Decode – Execution – Typical register and memory sequence instructions – Input, Output and Interrupt – *Design stages*. (9)

**CENTRAL PROCESSOR ORGANISATION:** General register organisation – Stack organisation – Instruction formats – Addressing modes – Data transfer and manipulation – Program control – Control memory – Address sequencer – *Data path structure - CISC characteristics, RISC Characteristics, RISC pipeline*. (8)

**ARITHMETIC PROCESSING:** Introduction – Addition, Subtraction, Multiplication and Division algorithms – Floating point Arithmetic operations - *BCD Arithmetic operations* (8)

**MEMORY AND INPUT/OUTPUT ORGANISATION:** Basic concepts – Memory Hierarchy – Main memory – Auxiliary memory – Associative memory – Cache and Virtual memory concepts – Input – Output interface – Asynchronous Data transfer – Modes of transfer – Direct memory access – *I/O processor*. (8)

**INTRODUCTION TO PARALLEL PROCESSING:** Parallelism in uniprocessor systems – Taxonomy of architectures – SISD, SIMD, MISD, MIMD modes of Memory access - shared memory, distributed memory – *typical applications*. (4)

Total 42

### TEXTBOOK:

1. Morris Mano M, "Computer System Architecture", Prentice Hall of India , New Delhi, Third Edition, 2000. Pearson Education, New Delhi.

**REFERENCES:**

1. Carl Hamacher V, Vranesic Z G and Zaky S G, "Computer Organisation", McGraw Hill International Edition, New York, Fifth Edition, 2002.
2. Kai Hwang and Briggs F A, "Computer Architecture and Parallel Processing", McGraw Hill International Edition, New York, 1985.

**08E510 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY****0 0 3 1.5**

1. Study of 8085 Microprocessor kit
2. Multi byte Binary Addition and Subtraction in 8085
3. Multi byte BCD Addition and subtraction in 8085
4. Table Processing using 8085
5. Multiplication and Division in 8085
6. Interfacing with 8085
  - a) Waveform Generation using 8255 b) Display unit
7. Addition and subtraction in 8051
8. Multiplication and Division in 8051
9. Programming 8051 on chip peripherals
10. Interfacing Stepper motor with 8085/8031

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E511 POWER ELECTRONICS LABORATORY****0 0 3 1.5**

1. Characteristics of MOSFET, IGBT, SCR and TRIAC
2. Single Phase and Three Phase Diode Bridge Rectifier with R and RL Load
3. Single Phase Half and Fully Controlled Thyristor converter with R and RL Load.
4. DC Chopper with R and RL Load
5. Single Phase AC Voltage Controller with R and RL Load
6. Construction and testing of Ups using Inverter
7. Three Phase PWM Inverter
8. Three Phase AC Voltage Controller with R and RL Load
9. Three Phase Fully Controlled Thyristor converter
10. Simulation of Power Electronic Circuits Using PSpice, PSIM and Simulink.

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E512 INSTRUMENTATION AND CONTROLS LABORATORY****0 0 3 1.5**

1. Transfer function of DC Motor. a) Armature Control Mode. b) Field Control Mode.
2. Transfer function of AC Servomotor and Study of Synchronos.
3. Time & Frequency Response of the System Using MATLAB.
4. Study of response of first and second order system using linear system simulator.
5. Study of response of 2<sup>nd</sup> order system with PID Controller using Simulink
6. Calibration of temperature sensors (RTD / thermo couple / thermistor).
7. Measurement of linear displacement using LVDT.
8. Measurement of strain using strain gauge.
9. Study of characteristics of inductive and capacitive transducers.
10. Study of characteristics of Piezo electric transducer.
11. Measurement of physical variable with the help of LAB View.

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E520 MINI PROJECT I****0 0 2 1**

- ❖ Problem Identification
- ❖ Project specifications
- ❖ Implementation ( Hardware / Software / both )
- ❖ Testing and validation of the developed system.
- ❖ Consolidated report preparation

## SEMESTER 6

### 08E601 ELECTRICAL MACHINE DESIGN

2 2 0 3

**GENERAL ASPECTS:** Major considerations – Limitations - Main dimension- Output equation - Choice of specific electric and magnetic loadings - Separation of D and L for rotating machines. (4)

**MAGNETIC CIRCUIT CALCULATIONS:** MMF for air gap - Effects of slots, ventilating ducts and saliency - MMF for teeth - Total mmf calculation - Leakage reactance. (6)

**ELECTRIC CIRCUIT CALCULATIONS:** Estimation of number of conductors / turns - Coils - Slots - Conductor dimension - Slot dimension. (5)

**DC MACHINES:** Choice of number of poles - Length of air gap - Design of field system, Interpoles, Commutator and Brushes. (5)

**TRANSFORMERS:** Classification – output equation - Core section - Window dimensions - Yoke dimension - Overall dimension - No load current calculation – Temperature rise of Transformers- *Design of tanks and cooling tubes.* (6)

**THREE PHASE INDUCTION MACHINES:** Length of air gap - Cage rotor - End ring current - Wound rotor - Dispersion coefficient. (5)  
No-load current calculation - Stator and rotor resistance - Losses and efficiency - Design of submersible motors (4)

**SYNCHRONOUS MACHINES:** Short circuit ratio – Air gap length –Salient pole machine -Design of field winding- Turbo-alternator – Damper winding. (5)

**COMPUTER AIDED DESIGN:** An Introduction (2)

Total 42

#### TEXT BOOKS:

1. Sawhney A K, Chakrabarti A, "A Course in Electrical Machine Design", Dhanpat Rai & Company, sixth edition 2006.
2. Mittle V N and Mittle A, 'Design of Electrical Machines', Standard Publications and Distributors, Delhi, 2002.

#### REFERENCES:

1. Sen S K, "Principles of Electric Machine Design with Computer Programmes", Oxford & IBH Publishing Co. Pvt. Ltd., 2001, Reprint 2004.
2. Agarwal R K, 'Principles of Electrical Machine Design', S.K.Kataria and Sons, Delhi, 2002.
3. Shanmugasundaram A, Gangadharan G and Palani R, "Electrical Machine Design Data Book", New Age international publishers (P) Ltd., 2005

### 08E602 OPERATING SYSTEMS

3 0 0 3

**INTRODUCTION:** Operating system – Function – Evolutions of Operating System- Serial processing- Batch Processing- Multiprocessing-Time sharing, Advanced Operating Systems –Need for advanced OS-Distributed OS – Multiprocessor OS – Database operating system – Real time OS-Introduction to CSP, MPI and PVM. (5)

**MEMORY MANAGEMENT:** Single contiguous allocation – Partitioned allocation – Paging – Virtual memory concepts – Swapping – Demand paging – Page replacement algorithms – Segmentation – Segmentation with paging. (9)

**PROCESS MANAGEMENT:** Introduction to processes –Scheduling objectives- Scheduling Criteria- Types of scheduling algorithms – Performance comparison – Inter process communications- Synchronization – Semaphores – Deadlock-Prevention, Recovery, Detection – Avoidance. (11)

**DEVICE AND FILE MANAGEMENT:** Principles of I/O hardware – I/O software – Disks – Disk Scheduling Algorithms–File Systems – Files-Directories- File system implementation – Allocation methods – Security – Protection mechanisms. (9)

#### CASE STUDIES:

**LINUX** – History – Design Principles – Kernel modules – Process Management – Scheduling – Memory Management – File Systems – Input and Output – Inter process Communication – Network Structure – Security.

**WINDOWS 2000** – History – Design Principles – System Components – Environmental Subsystems – File System – Networking – Programmer Interface. (8)

Total 42

#### TEXT BOOK:

1. Silberschatz A, Galvin P and Gagne G, "Operating Systems Concepts", Sixth edition, John Wiley & Sons, Singapore, 2004.

**REFERENCES:**

1. Andrew S Tanenbaum, Albert S Woodhull, "The MINIX book Operating Systems: Design and Implementation," Third Edition, Pearson Education Pvt Ltd, New Delhi 2006.
2. Achyut Godbole, "Operating Systems", Tata McGraw Hill Publishing Company, New Delhi, Fifteenth reprint 2003.
3. Deitel H M, "An Introduction to Operating Systems", Second Edition, Pearson Education Pvt Ltd, New Delhi, 2005.
4. Mukesh Singhal and Niranjana G Shivaratis, "Advanced Concepts in Operating Systems", McGraw Hill Inc., New Delhi, TMH Edition 2004.
5. William Stallings, "Operating Systems" Second Edition, Prentice Hall of India, New Delhi, 1997.
6. Dhamdhare D M, "Operating Systems: A Concept –based Approach," Second Edition, Tata McGraw-Hill Publishing Company Ltd, 2006

**08E603 HEAT ENGINES AND FLUID MACHINERY****3 0 0 3**

**HEAT ENGINES :** Steam power plant – Layout of modern steam power plant, principle of operation of modern high pressure boilers, condensers, cooling towers, draught system, steam turbines – impulse type, reaction type. Principles of operation of Gas turbine. (5)

IC Engines – Principles of operation, 2 stroke and 4 stroke engines, Petrol and Diesel engines. Carburetor, Electronic fuel injection, Diesel injection system, Ignition system, cooling and lubrication method. (6)

Performance characteristic of constant speed engines- Port timing and Valve timing diagram, calculation of fuel consumption, output power, mechanical and thermal efficiencies, Selection of engines. (5)

One dimensional heat conduction through plane wall, cylinder and spheres. Use of fins in heat transfer, elementary idea about free and forced convection. Heat exchanger – parallel, counter and cross flow. Principles of Radiation heat transfer. (5)

**FLUID MACHINERY:** Introduction – Layout of hydroelectric power plant, classification of turbines, energy transfer between fluid and rotor. Specific speed & its significance. (6)

Hydraulic turbines – impulse type, Pelton wheel, reaction type, Francis, Kaplan and Propeller – Principle of operation, performance of turbines, draft tube. (5)

Hydraulic pumps – classification, Reciprocating and centrifugal pumps, performance studies, fluid coupling and torque converter. (5)

Compressors – classification, Reciprocating and centrifugal compressors, applications, characteristics, Surging and stalling. (5)

**Total 42****TEXT BOOKS :**

1. Kothandaraman C P, and Domkundwar S, "Thermal Engineering", Dhanpat Rai and Sons, Delhi, 1989.
2. Ganesan V, " Internal Combustion Engines", Tata McGraw Hill Publishing Company Ltd, New Delhi, 1994.
3. Sachdeva R C, " Fundamentals of Engineering, Heat and Mass Transfer, New Age International Publishers, New Delhi, 1998
4. Bansal R K, " Fluid mechanics & Hydraulic machines ", Lakshmi Publications, 2003

**REFERENCE :**

1. Govinda Rao N S, "Fluid Flow Machines", Tata McGraw Hill Publishing Company Ltd, New Delhi, 1983

**08E604 GENERATION, TRANSMISSION AND DISTRIBUTION****3 0 0 3**

**POWER GENERATION:** Generation, Transmission & Distribution Scenario of India - Types of generation: Conventional and Non-conventional, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Non-conventional Energy Sources - Load capacity factor - Connected load factor - Load duration curve - Selection of units. (8)

**POWER TRANSMISSION SYSTEMS:** Various systems of transmission – Advantages of high transmission voltages - Comparison of conductor materials required for various overhead systems. (4)

**OVERHEAD LINES PARAMETERS:** Electrical constants - Resistance, Inductance and capacitance of Single and 3 Phase lines - Effects of earth on capacitance - Skin effect - Proximity effect - Transposition - Bundled conductors - Line supports. (6)

**PERFORMANCE:** Short and medium transmission lines - Phasor diagrams - Nominal T and Pi methods - Line regulation - Efficiency. Rigorous solution for long line - ABCD constants - Ferranti effect - Tuned power lines - Surge impedance and surge impedance loading. (6)

**LINE INSULATORS:** Types - Potential distribution over a string of suspension insulators - Methods of increasing string efficiency. Corona – Factors affecting corona - Stress and Sag Calculation – Effect of wind and ice - supports at different levels – Stringing chart. (6)

**UNDERGROUND CABLES:** Types - Capacitance and insulation resistance - Sheath effects - Grading - Stresses - Loss angle - Breakdown voltage - Optimum cable length -Comparison between overhead lines and underground cables. (6)

**DISTRIBUTION SYSTEMS:** Feeders, distributors and service mains - Radial and ring main systems - Calculation of voltage in distributors with concentrated and distributed loads, A.C. single phase and three phase distribution systems. (6)

**Total 42**

**TEXT BOOKS:**

1. Mehta V K, Rohit Mehta, "Principles of Power Systems", S.Chand & Co. Pvt. Ltd., New Delhi, 2004.
2. Singh S N, "Electric Power Generation, Transmission and Distribution", Prentice-Hall of India Pvt., Ltd, New Delhi, 2003.

**REFERENCES:**

1. Soni M L, Gupta P V, Bhatnagar U S and Chakrabarthy A, "A Text Book on Power System Engineering", Dhanpat Rai & Co., New Delhi, 1997.
2. Uppal S L, "Electrical Power", Khanna Publishers, New Delhi, Thirteenth Edition, 1995.
3. Wadhwa C L, "Electrical Power Systems", New Age International Publishers, Delhi, 2006 Fourth Edition Reprint Aug, 2007.
4. Gupta J B, "A Course in Electrical Power", S. K. Kataria & Sons, 2003
5. Gupta B R, "Generation of Electrical Energy", S.Chand & company New Delhi, Revised edition 2006
6. Kothari D P and Nagrath J, "Power System Engineering", Tata McGraw-Hill Publishing Company New Delhi, second Edition 2007
7. Deshpande M V, 'Electrical Power Systems Design', Tata McGraw-Hill Publishing Company New Delhi, 2004.
8. Allen J Wood and Wollenberg B F, Power Generation, Operation and Control, Second Edition, John Wiley, 1996.

## **08E605 DIGITAL SIGNAL PROCESSING**

**3 0 0 3**

**DISCRETE-TIME SIGNALS AND SYSTEMS:** Need and benefits of Digital Signal Processing – signal classification and basic operations on them – Properties of DT system: linear, time invariance, causal, stable, passive and lossless – LTI system: convolution sum- interconnection schemes- I/O relationship- determination of impulse response and step response -anti aliasing and anti imaging filtering-Typical DSP system: ADC/DAC – sampling, quantization, and encoding. (10)

**DISCRETE TRANSFORMS:** Discrete Fourier Transform (DFT): Properties – DIT FFT and DIF FFT algorithms- linear filtering via circular convolution-inverse FFT- Wavelet Transform: MRA by the wavelet method. (6)

**DESIGN OF DIGITAL FILTERS:** Characteristics of IIR and FIR filters -Design techniques for analog filters-frequency transformation-FIR filter design: windowing, frequency sampling and optimal methods- IIR filter design: impulse invariant and bilinear Z transform-Realization structures of filters: direct form, cascade, parallel, and lattice and ladder realization. (10)

**FINITE WORD LENGTH EFFECTS:** Finite word length effects in IIR and FIR filters –A/D quantization noise – Co-efficient quantization – overflow errors – Product round off errors-limit cycle due to product round off errors – Finite word length effects in FFT implementation. (8)

**GENERAL-PURPOSE DIGITAL SIGNAL PROCESSORS:** Computer architectures for signal processing – Van Neumann and Harvard architectures-pipelining-hardware multiplier-accumulator-special instructions-replication-on-chip memory-extended parallelism: SIMD, VLIW, and super scalar processing -selecting digital signal processors. (8)

**Total 42**

**TEXT BOOKS:**

1. Emmanuel C Ifeachor, Barrie W Jervis, "Digital Signal Processing, A practical approach", Pearson Education, New Delhi, second edition, 2004.
2. Lonnie C Ludeman, "Fundamental of Digital Signal Processing", John Wiley & Sons, 2003.

**REFERENCES :**

1. Oppenheim A V and Schaffer R W, "Discrete Time Signal Processing", Prentice Hall of India, New Delhi, 2001.
2. Sanjit K Mitra, "Digital Signal Processing, A Computer based Approach", Tata McGraw Hill, New Delhi, second edition, fifth reprint, 2004.
3. John G Proakis and Dimitris G Manolakis, "Digital signal Processing; Principles, Algorithms & Applications", Prentice Hall of India, New Delhi, Fourth edition, 2007.

## **08E610 HEAT ENGINES AND FLUID MACHINERY LAB**

**0 0 3 1.5**

1. Experimental Study of Valve Timing Diagram on Four Stroke IC Engines.
2. Experimental study of port timing diagram on two stroke IC engines

3. Performance Study of IC Engines.
4. Heat Balance Test on IC Engines.
5. Experimental Study on Variable Speed IC Engines.
6. Performance Test on Centrifugal Pumps.
7. Performance Test on Positive displacement pumps.
8. Load Test on Impulse Water Turbine.
9. Load Test on Reaction Water Turbine.
10. Performance Test on Centrifugal Blower.

**REFERENCES:**

Laboratory Manual Prepared by Mechanical Department

**08E611 DIGITAL SIGNAL PROCESSING LABORATORY**

**0 0 3 1.5**

1. Generation of DT signals and determination of impulse response of LTI systems
2. Implementation of overlap save and overlap add methods of convolution
3. Determination of frequency response of LTI systems
4. Spectral analysis of DT signals
5. Implementation of FFT algorithm.
6. Design of IIR filters by BLT method
7. Design of IIR filters by Impulse Invariant method
8. Design of FIR filters using windows
9. Design of FIR Filters by optimal method
10. Implementation of convolution sum using Digital Signal Processor.

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E620 MINI PROJECT II**

**0 0 2 1**

- ❖ Problem Identification
- ❖ Project specifications
- ❖ Implementation ( Hardware / Software / both )
- ❖ Testing and validation of the developed system.
- ❖ Consolidated report preparation

**08E621 INDUSTRIAL VISIT CUM LECTURE**

**1 0 2 2**

**Industrial Lecture**

Faculty will arrange for lectures by experts preferably from industries to highlight the recent technical and soft skill trends.

**Visit to Industries**

Study tour / Industrial visit. Reports are to represent the observations of the students after the visits with their personal comments / suggestions.

**SEMESTER 7**

**08E701 ELECTRIC DRIVES AND CONTROL**

**3 0 0 3**

**INTRODUCTION TO ELECTRIC DRIVES:** History and development of electric drives, Characteristics of Electrical & mechanical loads, Classification of electric drives, Basic elements & advantages of variable speed drives. Modes of operation, closed loop control of drives - Selection of power rating for drive motors with regard to thermal overloading and load variation. (7)

**DC DRIVES:** Speed control of DC motors - Ward - Leonard scheme - drawbacks - Thyristor converter fed dc drives: - Single, two and four quadrant operations - Chopper fed DC drives : - Time ratio control and current limit control - Single, two and four quadrant operations - Effect of ripples on the motor performance. (9)

**AC DRIVES:** Speed control of 3 phase Induction Motors - Stator control: PWM &V/f control, rotor control: Rotor resistance control - Static control of rotor resistance using DC chopper - Static Kramer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives - Speed control of 3 phase Synchronous Motors - True synchronous and self controlled modes of operations (9)

**RELUCTANCE MOTOR DRIVES:** DC servo drives principle of operation - AC servo drives principle of operation - Principle and control Stepper motor and SRM drives. (8)



**DIGITAL CONTROL AND DRIVE APPLICATIONS:** Digital techniques in speed control - Advantages and limitations - Microprocessor/Microcontroller and PLC based control of drives, networking of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Cement mills, Machine tools, Lifts and Cranes. Solar and battery powered drives. (9)

**Total 42**

**TEXT BOOKS:**

1. Dubey G K, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2003.
2. Bose B K, "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2003

**REFERENCES:**

1. Ion Boldea and Nasar S A", "Electric Drives", CRC Press LLC, New York, 1999.
2. Krishnan R, "Electric Motor Drives: Modelling, Analysis and Control, Prentice Hall of India, Pvt Ltd, New Delhi, 2002
3. Vedam Subramanyam, "Electric Drives: Concepts and Applications", Tata McGraw Hill Ltd, New Delhi, 2004.

## **08E702 COMPUTER AIDED POWER SYSTEM ANALYSIS**

**3 0 0 3**

**INTRODUCTION:** - Need for system analysis in planning and operation of power system- One line diagram- Per unit representation - Symmetrical components - short circuits analysis for fault on machine terminals. (8)

**NETWORK FORMULATION & MODELLING:** - Primitive network and its representation – bus incidence matrix – Formation of Bus admittance matrix and bus impedance matrices.- modeling of synchronous machines , transformers, loads,  $\Pi$ -equivalent circuit of transformer with off-nominal tap ratio. (6)

**SHORT CIRCUIT STUDIES:** Types of faults - Algorithms for fault calculations — sequence impedance matrices - Symmetrical and unsymmetrical fault analysis using  $Z_{bus}$ . (6)

**LOAD FLOW STUDIES:** Formulation of load flow problem - bus classification – Solution by Gauss - Seidal , Newton - Raphson and Fast decoupled methods - Comparison -. Computation of slack bus power, transmission loss and line flow. (8)

**ECONOMICAL OPERATION OF GENERATING STATIONS:** Optimal operation of generators – economical scheduling of thermal plant with and without transmission losses – Loss formula derivation- unit commitment - Elementary idea of optimal load scheduling of Hydro - Thermal plants. (6)

**STABILITY STUDIES:** Steady state and transient stability - Swing equation and its solution by modified Euler and Runge-Kutta methods - Equal area criterion - Factors affecting stability and methods of improving stability- Causes of voltage instability – voltage stability proximity indices for two-bus system (8)

**Total 42**

**TEXT BOOKS:**

1. Hadi Saadat, "Power System Analysis", Tata McGraw-Hill Editions ,2007
2. Gupta B R, "Power System Analysis and Design", S.Chand and company Ltd., New Delhi, 2005.

**REFERENCES:**

1. M A PAI, "Computer Techniques in Power System Analysis" Tata McGraw-Hill, Second edition, 2006
2. Wadhwa C L "Electrical Power Systems", New Age International (P) Ltd, New Delhi, Third Edition, 2003.
3. Kothari D P, Nagrath I J, "Power System Engineering "Tata McGraw-Hill, Second edition.
4. Nagsarkar T K, Sukhija M S, "Power system Analysis", Oxford University Press, 2007

## **08E703 ENERGY SOURCES AND UTILISATION**

**3 1 0 3.5**

**INTRODUCTION:** Trends in energy consumption - World energy scenario - Energy sources and their availability - Conventional and renewable sources - Need to develop new energy technologies (2)

**SOLAR POWER SYSTEMS:** Solar Thermal Systems: Principle of solar thermal power generation – Low, medium and high temperature systems. Solar Photovoltaic Systems: Solar cells and their characteristics - Influence of insolation and temperature - PV arrays – Series and parallel connections - Synchronised Operation with grid supply - Stand alone PV systems - Charge controllers. (7)

**WIND ENERGY SYSTEMS:** Nature and Power in the wind - Basic principle of wind energy conversion – Blade element Theory - Components of a wind energy conversion system - Classification of WECS – Betz model - Wind Turbines – Types - Horizontal axis and vertical axis wind turbines - Generator control - Load control. (5)

**MISCELLANEOUS SOURCES:** Energy From Oceans: Ocean thermal energy conversion systems - Energy from tides Ocean Waves - MHD Energy Conversions: Magneto Hydro Dynamic (MHD) power generation - Types - Fuel cells - Types - Energy from fusion Hybrid Systems: Range and type of Hybrid systems - Case studies of Diesel-PV and Wind-PV systems. (6)

**ELECTRIC TRACTION:** Requirements of traction system - Systems of traction - Comparison of electric traction and other forms of traction - Systems of track electrification - Comparison - Types of services - Speed - Time curves - Tractive effort - Power of traction motor - Specific energy consumption - Current collection systems - Motors for traction - Starting and speed control - Electric braking. (6)

**ELECTRIC HEATING AND WELDING:** Advantages of electric heating – Types of Heating - Resistance heating - Temperature control, Induction heating – induction furnace - Dielectric heating - Choice of voltage and frequencies for Dielectric heating - Resistance welding - Arc welding - Laser welding – Ultra sonic Welding (5)

**ELECTROLYSIS:** Review of electrolytic process principles - Laws of electrolysis - Electro plating. (2)

**ILLUMINATION:** Nature of light - Luminous intensity - Illumination - Brightness - Lamp efficiency - Luminous efficiency - Laws of illumination - Electrical sources of light – CFL - Fluorescent lamp, Sodium Vapour lamp, Mercury Vapour lamp - Polar curves - Calculation of illumination - Indoor lighting - Requirements of good lighting (4)

**ECONOMIC ASPECTS OF UTILISATION:** Introduction to Energy conservation and Energy auditing - Tools for Energy auditing, Case studies in Textile and Cement Industries - Tariffs - Influence of power factor - PF improvement. (5)

**Total 42**

**TEXT BOOKS:**

1. Rao S and Paruklekar, "Energy Technology – Non Conventional, Renewable and Conventional", Khanna Pub, New Delhi 1999.
2. Partab H, "Art and Science of Utilisation of Electric Energy", Dhanpat Rai & Sons, Third Edition, 1995.

**REFERENCES:**

1. Rai G D, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1993.
2. Khan B H, " Non-Conventional Energy Resources", Tata McGraw Hill, New Delhi 2006
3. Mukund R Patel, " Wind and Solar Power Systems", CRC Press LLC, New York, 1999.
4. Bhadra S N, Banerjee S, Kastha D, " Wind Electrical Systems " Oxford University Press, July 2005
5. Garg G C, "Utilisation of Electric Power and Electric Traction", Khanna Publishers, New Delhi, Third Edition, 1990.
6. Openshaw Taylor E "Utilisation of Electric Energy in SI Units.", Orient Longman Ltd, 2007, Eleventh reprint,
7. Uppal S L, "Electric Power", Khanna Publishers, New Delhi, Thirteenth Edition, 1997.

## **08E704 POWER SYSTEMS PROTECTION AND SWITCH GEARS**

**3 0 0 3**

**INTRODUCTION:** Principles and need for protective schemes – nature and cause of faults – types of fault – per unit representation - analysis of symmetrical fault – current limiting reactors. CTs and PTs and their applications in their protection schemes. (5)

**PROTECTIVE RELAYS:** Definition - Requirement of relays - Universal relay torque equation - Non directional and directional over current relays – Earth fault relays - Distance relays - Impedance, Mho and Reactance relays - Differential relays - Negative sequence relays - Pilot (Translay) relay – Power line carrier communication - Carrier and Microwave pilot relays – Under frequency relays - Introduction to static relays - Microprocessor and computer based protective relaying. (9)

**APPARATUS AND LINE PROTECTION:** Alternator, transformer, Busbar and motor protection using relays – Feeder Protection – radial and ring main system. Microprocessor based protective schemes. (7)

**CIRCUIT BREAKERS:** Functions of switchgear - Elementary principles of arc extinction - Arc control devices - Recovery voltage and restriking voltage - current chopping and capacitance current breaking - Bulk oil, low oil, air break, air blast, and sulphur hexafluoride and vacuum circuit breakers - HVDC breakers - Rating - Testing of circuit breakers. (7)

**SURGE AND SURGE PROTECTION:** Switching surges - Lightning phenomenon – Traveling waves on transmission lines - Over voltage due to lightning - Protections against lightning - Lightning arresters – Types - Lightning arrester selection - Surge absorbers. (7)

**EARTHING AND INSULATION CO-ORDINATION:** Solid, resistance and reactance Earthing - Arc suppression coil - Earthing transformers – Earth wires - Earthing of appliances- Insulation co-ordination: Definition - Determination of line insulation - Insulation levels of sub-station equipment - Co-ordination amongst items of substation equipment - Introduction to Indian Electricity rules. (7)

**Total 42**

**TEXT BOOKS:**

1. Badri ram and Vishwakarma D N , "Power System Protection and Switchgear" Tata McGraw Hill Publishing Company Ltd. New Delhi , 1995.
2. Ravindranath B and Chander M, "Power System Protection and Switchgear", New Age International Ltd., New Delhi, 1977.
3. Wadhwa C L, "Electrical Power Systems", New Age International Publishers, Delhi, 2006 Fourth Edition Reprint: Aug, 2007.

**REFERENCES:**

1. Paithankar Y G, Bhide S R, "Fundamentals of Power System Protection" Prentice - Hall of India Ltd, New Delhi – 2003.
2. Soni M L, Gupta P V, Bhatnagar U S and Chakrabarti A, "A Text Book on Power Systems Engineering", Dhanpat Rai & Co Ltd., Delhi, 2003.
3. Sunil S Rao, "Switchgear Protection and Power Systems", Khanna Publishers, Delhi, Eleventh Edition 1999

**08E710 POWER SYSTEMS LABORATORY****0 0 3 1.5**

1. Computation of Line Parameters and modelling of transmission lines
2. Formation of a bus admittance matrix (YBus) using singular transformation method.
3. Determination of a bus impedance matrix (ZBus) using building algorithm.
4. Gauss-Seidel method of solution of power-flow problem.
5. Newton-Raphson method of solving load-flow problem.
6. Symmetrical short circuit analysis.
7. Unsymmetrical short circuit analysis.
8. Economic Load Dispatch of thermal power plants.
9. Transient stability analysis of power systems using PSCAD.
10. Characteristics of over current / Thermal overload relays.

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E711 DESIGN LABORATORY****0 0 3 1.5**

1. Cross sectional 2D view of Electrical Machines using AUTOCAD
2. Effect of air gap variation for 3 -phase induction motor
3. Measurement of illumination for different types of lamp
4. Closed loop speed control of DC Motor using SIMULINK
5. 8086 Assembler Programming
6. Solar Cell Characteristics
7. Load test on Variable Frequency Drive
8. Interfacing Digital I/O card with IBM PC
9. CAD of Electrical Machines (DC/AC Machines)
10. Performance analysis of special machines using MotorPro

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

**08E720 PROJECT WORK I****0 0 6 3**

- ❖ Identification of a problem.
- ❖ Literature survey of identified problem.
- ❖ Finalization of project specification and requirements
- ❖ Presentation / Demonstration of sub block(s) of the Project ( Hardware / Software / both )

**SEMESTER 8****08E820 PROJECT WORK II****0 0 24 12**

- ❖ Project Implementation ( Hardware / Software / both )
- ❖ Presentation / Demonstration about the work done
- ❖ Consolidated report preparation

**ELECTIVES****MATHEMATICS****08O001 APPLIED NUMERICAL ANALYSIS****3 1 0 3.5****TYPES OF ERRORS:** Different types of errors

(2)

**SOLUTION OF ALGEBRAIC EQUATIONS:** Newton Raphson method, Modified Newton Raphson method, Method of false position, Graffe's root squaring method, Bairstow's method.

(6)

**OPTIMIZATION:** One dimensional unconstrained optimization-Golden-Section search, Quadratic Interpolation, Newton's method. (2)

**SOLUTION OF ALGEBRAIC SIMULTANEOUS EQUATIONS:** Gauss – Jordan elimination, Cholesky method, Crout's method, Gauss – Jacobi method, Gauss – Seidel method. Matrix Inverse by Gauss – Jordan method. (5)

**EIGENVALUES AND EIGENVECTORS:** Power method for finding dominant eigenvalue and inverse power method for finding smallest eigenvalue, Jacobi method for symmetric matrices. (3)

**FINITE DIFFERENCES AND INTERPOLATION:** Finite difference operators –  $E, \Delta, \nabla, \delta, \mu, D$ . Interpolation-Newton-Gregory forward and backward interpolation, Lagrange's interpolation formula, Newton divided difference interpolation formula. Solution of linear second order difference equations with constant coefficients. (8)

**DIFFERENTIATION AND INTEGRATION:** Numerical differentiation using Newton-Gregory forward and backward polynomials. Numerical Integration-Gaussian quadrature, Trapezoidal rule and Simpson's one third rule. (5)

**ORDINARY DIFFERENTIAL EQUATIONS:** Taylor series method, Euler and Modified Euler method, (Heun's method). Runge-Kutta method, Milne's method, Adams-Moulton method, Solution of boundary value problems of second order by finite difference method. (6)

**PARTIAL DIFFERENTIAL EQUATIONS:** Classification of partial differential equations of second order. Liebmann's method for Laplace equation and Poisson equation, Explicit method and Crank – Nicolson method for parabolic equations. Explicit method for hyperbolic equations. (5)

**MATLAB:** Matlab – Tools kits – 2D Graph plotting, 3D Graph plotting, Data analysis.

**Total 42**

#### REFERENCES:

1. Steven C Chapra and Raymond P Canale, "Numerical Methods for Engineers with Software and Programming Applications", Tata McGraw Hill, 2004.
2. John H Mathews and Kurtis D Fink, "Numerical Methods using MATLAB", Prentice Hall, 2004.
3. Curtis F Gerald and Patrick O Wheatly, "Applied Numerical Analysis", Pearson Education, 2002.
4. Rober J Schilling and Sandra L Harries, "Applied Numerical Methods for Engineers using MATLAB and C", Thomson Brooks/Cole, 1999

## 08O002 BUSINESS STATISTICS

**3 1 0 3.5**

**FREQUENCY DISTRIBUTION:** Grouping and Displaying data to convey meaning – Tables and graphs – Measures of central tendency and dispersion in frequency distributions. (6)

**PROBABILITY DISTRIBUTIONS:** Types of Probability – Probability rules – Probabilities under conditions of Statistical independence and dependence – Baye's theorem – Binomial, Poisson, Geometric, Exponential and Normal Distributions. (8)

**SAMPLING AND SAMPLING DISTRIBUTIONS:** Random Sampling – Design of Experiments – Sampling Distributions – Sampling - Sample size and standard error. (6)

**ESTIMATION:** Introduction -Point Estimates- interval Estimates – Basic Concepts – Interval Estimates and Confidence Intervals – Calculating Interval Estimates of the Mean from Large Samples – Calculating Interval estimates of the Proportion from Large samples – Interval Estimates using the t Distribution – Determining the sample size in estimation. (6)

**TESTING OF HYPOTHESES:** One sample tests – Introduction – Concepts Basic to the Hypothesis – Testing Procedure – Testing Hypotheses – Hypothesis Testing of Means - Population Standard Deviation – Measuring the power of a Hypothesis test – Hypothesis Testing of Proportions – Large Samples – Hypothesis Testing of Means. (6)

**REGRESSION AND CORRELATION:** Estimation using the Regression Line – Correlation Analysis – Making Inferences about population parameters – Using Regression and correlation analyses – Limitations. Errors and Caveats - Multiple Regression and Correlation Analysis – Finding the Multiple – Regression Equation - The Computer and Multiple Regression – Making Inferences about Population Parameters – Modeling Techniques. (6)

**TIME SERIES AND FORECASTING:** Variations in Time Series – Trend Analysis – Cyclical Variation – Seasonal Variation – Irregular Variation – A Problem Involving all Four Components of a Time Series – Time Series Analysis in Forecasting. (4)

**Total 42**

#### REFERENCES:

1. Paul Newbold, William Carlson and Betty Thorne, "Statistics for Business and Economics", Pearson Education, 2007.
2. Richard I Levin and David S Rubin, "Statistics for Management", Pearson Education, 2005.
3. Mark Berenson, Timothy Krehbiel and David Levine, "Basic Business Statistics", Pearson Education, 2005.

## 08O003 MATHEMATICAL MODELING

3 1 0 3.5

**INTRODUCTION TO MODELING:** Modeling process, Overview of different kinds of models. (2)

**EMPIRICAL MODELING WITH DATA FITTING:** Error functions, least squares; fitting data with polynomials and splines. (4)

**QUALITATIVE MODELING WITH FUNCTIONS:** Modeling species propagation, supply and demand, market equilibrium, market adjustment. Inventory Models- Various types of inventory models with shortage and without shortage, Probabilistic Models. (10)

**CAUSAL MODELING FORECASTING:** Introduction, Modeling the causal time series, forecasting by regression analysis, prediction by regression. Planning, development and maintenance of linear models, trend analysis, modeling seasonality and trend. (8)

**DECISION MAKING:** Decisions under un certainty, under certainty, under risk –Decision trees- Expected value of perfect information and imperfect information. (8)

**MODELING WITH SIMULATION:** Principles of Computer modeling and simulation, Monto-Carlo Simulation, Limitation of Simulation, areas of application, discrete and continuous systems, variety of modeling approaches. Techniques of Random number generation- Midsquare method, midproduct method, Constant multiplier technique, additive congruential method, linear congruential method. Tests for random numbers- The Kolmogorov –Simmov test- The chi-square test. (10)

**Total 42**

### REFERENCES:

1. Hamdy A Taha, "Operation Research", Pearson Education, 2002.
2. Jerry Banks, John S Carson and Barry L Nelson, "Discrete Event system Simulation", Prentice Hall, 2002.
3. Edward A Bender, "An Introduction to Mathematical Modeling", Dover, 2000.
4. Averil M Law and W David Kettlton W," Simulation modeling and Analysis", Tata Mc-Graw Hill,2000.
5. Giordano F R, Weir M D and Fox W P, "A First Course in Mathematical Modeling" Brooks/ Cole 1997.

## 08O004 OPTIMIZATION TECHNIQUES

3 1 0 3.5

**INTRODUCTION:** Statement of an optimization problems – classification of optimization problem – classical optimization techniques; Single variable optimizations, Multi variable optimization, equality constraints, Inequality constraints, No constraints. (3)

**LINEAR PROGRAMMING:** Graphical method for two dimensional problems – central problems of Linear Programming – Definitions – Simplex – Algorithm – Phase I and Phase II of Simplex Method – Revised Simplex Method. (6)

Simplex Multipliers – Dual and Primal – Dual Simplex Method – Sensitivity Analysis – Transportation problem and its solution – Assignment problem and its solution by Hungarian method – Karmakar's method – statement, Conversion of the Linear Programming problem into the required form, Algorithm. (7)

**NON LINEAR PROGRAMMING (ONE DIMENSIONAL MINIMIZATION:** Introduction – Unrestricted search – Exhaustive search – Interval halving method – Fibonacci method. (5)

**NON LINEAR PROGRAMMING : (UNCONSTRAINED OPTIMIZATION):** – Introduction – Random search method – Uni variate method – Pattern search methods – Hooke and Jeeves method, Simplex method– Gradient of a function – steepest descent method – Conjugate gradient method. (7)

**NON LINEAR PROGRAMMING – (CONSTRAINED OPTIMIZATION):** Introduction – Characteristics of the problem – Random search methods – Complex method. (5)

**DYNAMIC PROGRAMMING:** Introduction – multistage decision processes – Principles of optimality – Computation procedures. (5)

**DECISION MAKING:** Decisions under uncertainty, under certainty and under risk – Decision trees – Expected value of perfect information and imperfect information. (4)

**Total 42**

### REFERENCES:

1. Kalyanmoy Deb, "Optimization for Engineering Design, Algorithms and Examples", Prentice Hall, 2004.
2. Hamdy A Taha , "Operations Research – An introduction", Pearson Education , 2002.
3. Hillier Lieberman, "Introduction to Operations Research", Tata McGraw Hill Publishing Company Ltd, 2002.
4. Singiresu S Rao, "Engineering Optimization Theory and Practice", New Age International, 1996.
5. Mik Misniewski, "Quantitative Methods for Decision makers", MacMillian Press Ltd., 1994.
6. Kambo N S, "Mathematical Programming Techniques", Affiliated East – West Press, 1991.

## 080005 STATISTICAL QUALITY CONTROL

3 1 0 3.5

**PROBABILITY, RANDOM VARIABLES, THEORETICAL DISTRIBUTIONS:** Axiomatic approach to probability – Random variables, Discrete random variables: Bernoulli, Binomial, Geometric and Poisson distributions, Continuous random variables: Uniform, Exponential, Normal distributions, Applications. (6)

**THEORY OF ATTRIBUTES:** Classes and class frequencies – Consistency of data – Independence of attributes – Association of attributes, Yule's coefficient of Association – Coefficient of colligation. (5)

**ESTIMATION:** Point estimation – Characteristics of estimation – Methods of estimation – Interval estimation – Interval estimates of mean, standard deviation, proportion, difference in means and ratios of standard deviation. (6)

**TESTING OF HYPOTHESIS AND ANALYSIS OF VARIANCE:** Large Sample Tests – Tests for means, variances and proportions. Small Sample Tests – Tests for means variances and attributes. Design of Experiments – ANOVA, completely randomized design, Randomized block design, Latin square design. (8)

**STATISTICAL QUALITY CONTROL:** Statistical basis for control charts – control limits – control charts for variables – charts for defective – charts for defects. (6)

**SAMPLING AND ACCEPTANCE SAMPLING BY ATTRIBUTES:** Single sampling plan – Double sampling plan – Multiple sampling plan – Type A and Type B OC curves, consumer's risk, producer's risk. ASN, ATI, AOQ curves MIL-STD-105D sampling plans. (5)

**CONCEPT OF RELIABILITY, HAZARD RATE AND MEAN TIME TO FAILURE:** Mathematical models for reliability studies – Normal, Exponential and Weibull failure laws. System failure rate, system mean time to failure, Series system, Parallel system, (k,n) system, Series-Parallel system. (6)

**Total 42**

### REFERENCES:

1. Jay L Devore, "Probability and Statistics for Engineering and Sciences", Thomson Duxbury, 2007.
2. Douglas C Montgomery and George C Runge, "Applied Statistics and Probability for Engineers", John Wiley and Sons, 2006.
3. Sheldon Ross, "A First course in Probability", Pearson Education, 2005.
4. Dale H Besterfield, "Quality Control", Prentice Hall, 2003.
5. Charles E Ebeling, "An Introduction to Reliability and Maintainability Engineering", McGraw Hill, 2000.

## 080006 STOCHASTIC MODELS

3 1 0 3.5

**PROBABILITY AND CONCEPT OF RANDOM VARIABLE:** Concepts of Probability – Conditional Probability – Independent Events – Baye's Theorem - Random Variables – Jointly Distributed Random Variables – Expectations of Random Variables – Conditional Expectations. (8)

**PROBABILITY DISTRIBUTIONS AND APPLICATIONS:** Discrete Distributions: Binomial, Poisson and Geometric. Continuous Distributions: Uniform, Exponential, Normal, Weibull and Erlang distributions – MGF-Mean and Variance. (8)

**STOCHASTIC PROCESSES:** Introduction – Classification of Stochastic Processes – Markov Chain: Introduction -Transition Probability Matrices – Chapman Kolmogorov Equations - Classification of Sates – Limit Theorems – Applications. (9)

**CONTINUOUS TIME MARKOV CHAINS:** Introduction – Poisson Process - Birth and Death Processes – Kolmogorov Differential Equations – Pure Birth Process - Pure Death Process - Applications. (7)

**QUEUEING THEORY:** Introduction – Characteristics – Steady State Solution: M/M/1, M/M/c, M/M/c/k Models- Queues with unlimited Service – Open Queuing Networks – Closed Queuing Networks – Cyclic Queues – Applications. (10)

**Total 42**

### REFERENCES:

1. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Processes", Prentice Hall, 2005.
2. Sheldon M Ross, "Stochastic Processes", John Wiley & Sons, Inc., 2004.
3. Sheldon M Ross, "Introduction to Probability Models", Academic Press, 2003.
4. Medhi J, "Stochastic Processes", New Age International Publishers, 2002.
5. Samuel Karlin and Howard E Taylor, "A First course in Stochastic Processes", Academic Press, 2002
6. Minh D L (Paul), "Applied Probability Models", Duxbury Thomson Learning, 2002
7. Gross D and Harrish C M, "Fundamentals of Queuing Theory", John Wiley & Sons, New Delhi, 1998

## PHYSICS

### 080016 MICRO MACHINING AND MICRO SENSORS

3 0 0 3

**MEMS AND MICROSYSTEMS:** MEMS and microsystem products. Evaluation of microfabrication. Microsystems and microelectronics. Applications of microsystems. Working principles of microsystems - microsensors, micro actuators, MEMS and microactuators, microaccelerometers. (5)

**SCALING LAWS IN MINIATURIZATION:** Introduction. Scaling in geometry. Scaling in rigid body dynamics. The Trimmer force scaling vector – scaling in electrostatic forces, electromagnetic forces, scaling in electricity and fluidic dynamics, scaling in heat conducting and heat convection. (5)

**MATERIALS FOR MEMS AND MICROSYSTEMS:** Substrates and wafers. Silicon as a substrate material. Ideal substrates for MEMS. Single crystal Silicon and wafers crystal structure. Mechanical properties of Si. Silicon compounds - SiO<sub>2</sub>, SiC, Si<sub>3</sub>N<sub>4</sub> and polycrystalline Silicon. Silicon piezoresistors. Gallium arsenide. Quartz – piezoelectric crystals. Polymers for MEMS. Conductive polymers. (8)

**MICROSYSTEM FABRICATION PROCESS:** Photolithography. Photoresist and applications. Light sources. Ion implantation. Diffusion process. Oxidation – thermal oxidation. Silicon diode. Thermal oxidation rates. Oxide thickness by colour. Chemical vapour deposition – principle, reactants in CVD. Enhanced CVD physical vapour deposition. Sputtering. Deposition by epitaxy. Etching – chemical and plasma etching. (8)

**MICRODEVICES:** Sensors – classification of sensors – signal conversion – ideal characterisation of sensors – mechanical sensors – measurands – displacement sensors – pressure and flow sensors. (8)

**MICROMANUFACTURING AND MICROSYSTEM PACKAGING:** Bulk micromachining. Isotropic and anisotropic etching - wet etchants, etch stops, dry etching comparison of wet and dry etching. Dry etching – physical etching – reactive ion etching, comparison of wet and dry etching. Surface micromachining - process in general, problems associated in surface micromachining. The LIGA process – description, materials for substrates and photoresists, electroplating, the SLIGA process. Microsystem packaging - General considerations. The three levels of microsystem packaging – die level, device level and system level. Essential packaging technologies – die preparation – surface bonding, wire bonding and sealing. Three dimensional packaging. Assembly of microsystem – selection of packaging materials.

Total 42

#### REFERENCES:

1. Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2002.
2. Julian W Gardner, "Microsensors: Principles and Applications", John Wiley and Sons, New York, 2001.
3. Chang C Y and Sze S M, "VLSI Technology", Mc Graw Hill, New York, 2000.
4. Kovacs G T A, "Micromachined Transducers Sourcebook", McGraw Hill, New York, 1998.
5. Mark Madou, "Fundamentals of Microfabrication", CRC Press, New York, 1997.
6. Sze S M, "Semiconductor Sensors", McGraw Hill, New York, 1994.

### 080017 NANO SCIENCE AND TECHNOLOGY

3 0 0 3

**INTRODUCTION AND CLASSIFICATION:** Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. (8)

**NANOMATERIALS AND CHARACTERIZATION:** Fabrication methods – Top down processes – Milling, lithographics, machining process – Bottom-up process – Vapour phase deposition methods, plasma-assisted deposition process, MBE and MOVPE, liquid phase methods, colloidal and solgel methods – Methods for templating the growth of nanomaterials – Ordering of nanosystems, self-assembly and self-organisation – Preparation, safety and storage issues. (8)

**GENERIC METHODOLOGIES FOR NANOTECHNOLOGY:** Characterisation: General classification of characterisation methods – Analytical and imaging techniques – Microscopy techniques - Electron microscopy, scanning electron microscopy, transmission electron microscopy, STM, field ion microscopy, scanning tunnelling microscopy, atomic force microscopy – Diffraction techniques – Spectroscopy techniques – Raman spectroscopy – Surface analysis and depth profiling – Mechanical properties, electron transport properties, magnetic and thermal properties. (8)

**INORGANIC SEMICONDUCTOR NANOSTRUCTURES:** Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, lithography and etching, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques. (6)

**SELF ASSEMBLING NANOSTRUCTURED MOLECULAR MATERIALS AND DEVICES:** Introduction – Building blocks – Principles of self-assembly, non-covalent interactions, intermolecular packing, nanomotors – Self assembly methods to prepare and pattern nanoparticles – Nanoparticles from micellar and vesicular polymerization, functionalized nano particles, colloidal nanoparticles crystals, self-organizing inorganic nano particles, bio-nanoparticles – nanoobjects. (6)

**NANODEVICES AND THEIR VARIOUS APPLICATIONS:** Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Magneto resistance – Probing nanomagnetic materials – Nanomagnetism in technology – Carbon nanotubes – fabrication- applications – Organic FET, organic LED's – Organic photovoltaics – Injection lasers, quantum cascade lasers, optical memories, electronic applications, coulomb blockade devices. (6)

**Total 42**

**REFERENCES:**

1. Kelsall Robert W Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", Wiley Eastern, 2004.
2. Michael Kohler, Wolfgang, Fritzsche, "Nanotechnology: Introduction to Nanostructuring Techniques", 2004.
3. William Goddard, Donald W Brenner, "Handbook of Nano Science Engineering and Technology", CRC Press, 2004.
4. Bharat Bhushan, "Springer Handbook of Nanotechnology", 2004.
5. Charles P Poole, Frank J Owens, "Introduction to Nanotechnology", John Wiley and Sons, 2003.
6. Mark Ratner, Danial Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Pearson, 2003.
7. Gregory Timp, "Nanotechnology", Springer-Verlag, 1999.

## 08O018 INTEGRATED CIRCUIT TECHNOLOGY

**3 0 0 3**

**INTEGRATED CIRCUITS:** Monolithic integrated circuits - origin of silicon and its purification - crystal growth, doping, wafer manufacture, crystal orientation, growth of silicon dioxide, oxidation process, oxide evaluation, thickness, contamination and oxidation reaction. (8)

**EPITAXIAL DEPOSITION:** Reactor - growth sequence, evaluation - impurity introduction and redistribution, diffusion – definition, process, mathematical analysis of diffusion, evaluation, ion implantation and its evaluation - non epitaxial CVD process. (8)

**PHOTOLITHOGRAPHY:** Process overview – photoresist, process sequence, photomasks, wafer fabrication environment, chemicals and cleaning procedures, particle monitoring technology personal and clean room procedures. (9)

**IC RESISTORS:** Sheet resistance, geometrical factors, diffused resistors, tolerance, temperature coefficient, pinch resistors, thin and thick film resistors, IC capacitors, oxide capacitors, junction capacitors, thin and thick film capacitors. (9)

**IC TRANSISTORS:** NPN transistors, current gain, breakdown voltage, saturation voltage and resistance, leakage currents, noise, frequency response, switching transistors, PNP transistors, diodes, Zener diodes, Schottky barrier diodes, Maximum voltage, current, power and frequency. (8)

**Total 42**

**REFERENCES:**

1. Peter Gise and Richard Blanchard,- "Modern Semiconductor Fabrication Technology", Prentice Hall, 1986.
2. John Allison, "Electronic Integrated Circuits-Their Technology and Design", McGraw Hill, 1975
3. Hans R Camenzind, "Electronic Integrated Systems Design", Van Nostrand Reinhold Co.,1972.

## 08O019 THIN FILM TECHNOLOGY

**3 0 0 3**

**EVAPORATION THEORY:** Cosine law of emission. Emission from a point source. Mass of material condensing on the substrate. (3)

**PREPARATION OF THIN FILMS:** Chemical methods: Qualitative study of preparation of thin films by Electroplating, vapour phase growth and anodization. Physical methods: Vacuum evaporation - Study of thin film vacuum coating unit - Construction and uses of vapour sources-wire, sublimation, crucible and electron bombardment heated sources. Arc and Laser evaporation. Sputtering - Study of glow Discharge - Physical nature of sputtering - Sputtering yield - Experimental set up for DC sputtering, AC sputtering and RF sputtering. Nucleation and growth of thin films (qualitative study only): Four stages of film growth. (9)

**DEPOSITION MONITORING AND CONTROL:** Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. **Thickness measurement:** Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only). (8)

**ELECTRICAL PROPERTIES:** Sheet resistance - size effect - Electrical conduction in thin metallic films. Effect of Ageing and Annealing - Oxidation - Agglomeration. (5)

**DIELECTRIC PROPERTIES:** DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity. (7)



**OPTICAL PROPERTIES:** Optical constants and their determination - Spectrophotometer method. Antireflection coatings. Interference filters. Thin film Solar Cells  $\text{CuInSe}_2$  solar cell. (5)

**APPLICATION OF THIN FILMS:** Thin film resistors: Materials and Design of thin film resistors (Choice of resistor and shape and area) - Trimming of thin film resistors - sheet resistance control - Individual resistor trimming. Thin film capacitors: Materials - Capacitor structures - Capacitor yield and capacitor stability. Thin film field effect transistors: Fabrication and characteristics - Thin film diodes. (5)

**Total 42**

**REFERENCES:**

1. Rao V V, Ghosh T B, Chopra K L, "Vacuum Science and Technology", Allied Publications, 1998.
2. Goswami A, "Thin Film Fundamentals", New Age International (P) Ltd., 1996.
3. Aicha Elshabini-Riadaud Fred D Barlow III, "Thin Film Technology Hand book", Mc Graw Hill Company, 1997.
4. Maissel L I and Glang R, "Hand Book of Thin Film Technology", McGraw Hill, 1970.
5. Berry R W and others, "Thin Film Technology", Mc Graw Hill Company, 1970.
6. Chopra K L, "Thin Film Phenomena", McGraw Hill, 1969.
7. Anders H, "Thin Films in Optics", Focal press, 1967.
8. Schwartz B and Schwartz N, "Measurement Techniques for Thin Films", John Wiley & Sons, 1967.
9. Guthrie A, "Vacuum Technology" John Wiley and Sons, 1963.
10. Holland L, "Vacuum Deposition of Thin Films", Chapman and Hall, 1956.
11. Heavens O S, "Thin Film Physics", Butter worths scientific publications, 1955.

## 08O020 LASER TECHNOLOGY

**3 0 0 3**

**EMISSION AND ABSORPTION OF RADIATION:** Einstein coefficients - negative absorption, shape and width of spectral lines, spontaneous and stimulated emission. (6)

**THRESHOLD CONDITION:** Rate equations - optical excitation in three and four level lasers, standing waves in a laser, cavity theory, modes, diffraction theory of the Fabry - Perot interferometer. (6)

**LASERS WITH SPHERICAL MIRRORS:** Types of resonators, stability diagram - coherence - spatial and temporal. (5)

**LASER MATERIALS:** Activator and host materials for solid lasers - growth techniques for solid laser materials - Bridgman and Stock-Berger technique - Czochralski and Kyropoulos techniques. (5)

**TYPES OF LASERS: (A)** Gas lasers - He-Ne laser -  $\text{Ar}^+$ , He-Cd<sup>+</sup> lasers -  $\text{N}_2$  and  $\text{CO}_2$  lasers - Fabrication and excitation mechanisms. **(B)** Liquid lasers, dye lasers, fabrication and excitation mechanisms. **(C)** Solid lasers - Ruby, Nd:YAG, glass - semiconductor diode lasers, Excimer Laser, Erbium doped laser. (9)

**LASER Q SWITCHING:** Mode-locking, second harmonic generation, theory and experiment, materials for optical SHG. (6)

**APPLICATIONS:** Laser communications, holography, industrial applications: cutting, drilling & welding, medical. Spectroscopic (qualitative), laser Raman effect, stimulated Raman effect - Brillouin scattering. (5)

**Total 42**

**REFERENCES:**

1. Sona, Gordan and Breach, "Lasers and Applications", Scientific Publishers Inc., New York, 1976.
2. Lengyel B A, "Lasers", Wiley-Inter Science, 1971.
3. Marshall S L, "Laser Technology and Applications", McGraw Hill Book Co., 1980.
4. Bloom A L, "Gas Lasers", John Wiley & Sons Inc., New York, 1968.

## 08O021 COMPOSITE MATERIALS

**3 0 0 3**

**INTRODUCTION:** Reinforcement – Fibres – Glass fibre, Aramid fibre, Carbon fibre, boron fibre – Fabrication – Properties – Applications – Comparison of fibres – Particulate and whisker reinforcements. Matrix materials – Properties. (7)

**REINFORCEMENT – MATRIX INTERFACE:** Wettability – Effect of surface roughness – Interfacial bonding – Methods for measuring bond strength. (5)

**POLYMER MATRIX COMPOSITES:** Types – Processing – Thermal matrix composites – Hand layup and spray technique, filament winding, Pultrusion, resin transfer moulding, autoclave moulding – Thermoplastic matrix composites – Injection moulding, film stacking – Diaphragm forming – Thermoplastic tape laying. Glass fibre/polymer interface. Mechanical properties – Fracture. Applications. (7)

**METAL MATRIX COMPOSITES:** Types. Important metallic matrices. Processing – Solid state, liquid state, deposition, insitu. Sic fibre / Titanium interface. Mechanical properties. Applications. (6)

**CERAMIC MATRIX COMPOSITES:** Ceramic matrix materials – Processing – Hot pressing, liquid infiltration technique, Lanxide process, insitu chemical reaction techniques – CVD, CVI, sol gel process. Interface in CMCs. Mechanical properties – Thermal shock resistance – Applications. (7)

**GEOMETRICAL ASPECTS:** Unidirectional laminas – Volume fraction and weight fraction – Woven roving, in-plane random fibres – Fibre length and fibre orientation distribution – Voids – Fibre orientation during flow. (5)

**FATIGUE AND CREEP IN COMPOSITE MATERIALS:** Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites – Hybrid composites – Thermal fatigue – Creep. (5)

**Total 42**

**REFERENCES:**

1. Mathews F L and Rawlings R D, "Composite Materials: Engineering and Science", CRC Press and Woodhead Publishing Limited, 2002.
2. Krishnan K Chawla, "Composite Materials Science and Engineering", Springer, 2001.
3. Handbook of Composites – American Society of Metals, 1990.
4. Derek Hull, "An introduction to Composite Materials", Cambridge University Press, 1988.

## 08O022 ELECTRONIC CERAMICS

**3 0 0 3**

**STRUCTURE OF CERAMIC MATERIALS:** Pauling's rule – Oxide structures Silicate structures – Clay minerals – polymorphism: displacive transformations, reconstructive transformation, Silica. (8)

**STRUCTURE OF GLASSES:** Glass formation – Random network model – structure of oxide glasses – glass formation – composition as a variable, heat flow and precipitation from glasses – growth controlled by diffusion of solutes – crystalline glasses – enamels – photosensitive and photochromic glasses. (9)

**OUTLINE OF ELECTRICAL PROPERTIES:** Conductivity of ceramic materials – ceramic semiconductors and their uses as fixed resistors, heating elements, thermistors and varistors – piezoelectric ceramics – insulators. (6)

**DIELECTRIC MATERIALS:** Electronic, ionic, orientation and space charge polarization mechanisms. Electrical properties such as capacitive loss, dielectric conductivity and dielectric strength. Structural dielectric materials. Ferroelectric theory, ferroelectric state based on local field. Effects of temperature, environment, composition and grain size. Anti-ferroelectric and ferroelectric transition. (8)

**PIEZOELECTRIC CERAMICS:** Parameters for piezoelectric ceramics and measurement. General characteristics and fabrication of PZT. Applications. (5)

**ELECTRO-OPTIC CERAMICS:** Birefringence. Non-linear effects in large electric fields. pockets effect. Kerr effect. Second harmonic generation. Measurement of electro-optic properties. Applications. (6)

**Total 42**

**REFERENCES:**

1. Moulson A J and Herbert J M, "Electro Ceramics", Ed. 2, John Wiley & Sons Ltd., 2003.
2. William F Smith, "Foundations of Materials science and Engineering", McGraw Hill Book Co., 2000.
3. Kingery, "Introduction to Ceramics", John Wiley Publications, 1991.
4. Michel W Barsoum, "Fundamentals of Ceramics", McGraw Hill Book Co., 1997.
5. Van Vlack, "Physical Ceramics for Engineers", Addison Wesley, 1964.

## 08O023 PLASMA TECHNOLOGY

**3 0 0 3**

**DISCHARGE PHYSICS AND GLOW DISCHARGE:** Types of Discharges: AC and DC discharges - glow - arc - corona - rf - ecr discharges - conduction in ionized gases. Diffusion: Diffusion and mobility - mean free path and collision frequency - free diffusion - mobility - ambipolar diffusion - transition diffusion - diffusion in magnetic field and fully ionized plasma. General structures and features: V-I characteristics - cathode layer - positive column - discharge in fast gas flow - glow discharge instabilities and their consequences - thermal stability. (10)

**ARC DISCHARGE:** Definition and characteristics - features of arc discharge - types of arcs, high intensity arcs - classification of arcs- free burning arc - wall, vortex, electrode, forced convection and magnetically stabilized arcs - Non thermal arcs; low pressure and low intensity arcs - initiation of arcs - low pressure arc with externally heated cathode - plasma temperature - V-I characteristics - electron and gas temperatures. (8)

Thermally induced random motion of particles - distribution of temperature and velocity in a gas - ionization of atoms and molecules - Saha equation - degree of ionization - electron concentration - thermodynamic equilibrium of plasma in an electrical discharge - definition of thermodynamic properties of plasma. (7)

**LABORATORY PLASMA SOURCES/DEVICES:** Low temperature plasma generation - transferred and non-transferred arc torches and their characteristics - heat transfer efficiency of plasma torches - design accepts - special type of torch for metallurgical applications - vacuum plasma torches - rf torch and their characteristics. (7)

**APPLICATIONS:** Plasma spraying of ceramic, alloys and metals - vacuum spraying - plasma reduction of ores and minerals - plasma disassociation of compound oxides - plasma refining and remelting - plasma furnace in steel making - plasma cutting - sputtering - plasma enhanced chemical vapour deposition - plasma nitriding and surface cleaning. (7)

**PLASMA DIAGNOSTICS:** Electrical probe techniques - spectroscopic methods - charged particle methods - energy balance technique. (3)

**Total 42**

**REFERENCES:**

1. Taritkumar Bose, "High Temperature Gas Dynamics", Springer, 2004.
2. Brown S C, "Introduction to Electrical Discharge in Gases", John Wiley, New York, 1996.
3. Yuri P Raizer, "Gas Discharge Physics", Springer – Verlag, Berlin, 1991.
4. Rosnagel S M, Cuomo J J and Westwood W D, "Handbook of Plasma Processing Technology", William Andrew Publishing, 1990.
5. Plasma Metallurgy, "The principles of materials science monographs", 23, Vladimir Dembovsky, Elsevier Science, Jan. 1985.
6. Francis F Chen, "Introduction to Plasma Physics", Plenum press (New York), 1984.
7. George Schmidt, "Physics of High Temperature Plasma", Academic press, New York, 1979.
8. Dresvin S V and Donskoi A V, "Physics and Technology of Low Temperature Plasmas", John Wiley and Sons, 1977.
9. Lochite W and Holtgreven, "Plasma Diagnostics", North Holland Publishing Company, 1968.
10. "Plasma Physics and Controlled Nuclear Fusion Research", Vol.1,2 & 3, IAEA Publication.
11. "Plasma Processing and Synthesis of Materials", Materials Research Society Symposia Proceedings, Vol. 30.

## 08O024 COMPUTATIONAL MATERIALS SCIENCE

**3 0 0 3**

**INTRODUCTION:** Introduction: Simulation as a tool for materials science, Modelling of Natural phenomena.– Types of models: Quantum mechanical, atomistic, mesoscopic, continuum – Multiscale approaches. (7)

**ELEMENTS OF DIFFERENTIAL EQUATIONS:** Differential equations in discrete and continuum simulation methods – Ordinary differential equations for particle dynamics, partial differential equations, condition / diffusion equation. (6)

**EMPIRICAL METHODS AND COARSE GRAINING:** Introduction - Reduction to classical potentials – polar systems, Vander Waals potential, potential for covalent bonds, Embedded-atom potential. The Connolly – Williams, approximation – Lattice gas model, Connolly Williams approximation; Potential renormalization. Basic idea; Two step renormalization scheme. The first step, second step and applications to Si. (8)

**MONTE CARLO METHODS:** Introduction to probability and statistics – Basics of the Monte Carlo method – Stochastic processes, Markov process and Ergodicity. Algorithms for Monte Carlo simulation – Random Numbers, simple sampling technique, importance of sampling technique, General comments on dynamic models. Applications to systems of classical particles, modified Monte Carlo techniques, percolation and polymer systems. (8)

**APPLICATIONS OF MONTE-CARLO:** Random walk, self-avoiding walk. Classical spin system- Ising model, Nucleation, crystal growth, Fractal system. (6)

**QUANTUM MONTE CARLO (QMC) METHODS:** Introduction - Variational Monte Carlo methods, Diffusion Monte Carlo method, path integral Monte Carlo method, Quantum spin models and other Quantum Monte Carlo methods. (7)

**Total 42**

**REFERENCES:**

1. Richard Catlow and Eugene Kotomin, "Computational Materials Science", IOS Press, 2003.
2. Meyer M and Pontikis V, "Computer Simulation in Material Science: Inter atomic potentials, simulation techniques and applications", Kluwer, Academic press, 2002.
3. Ohno K, Esfarjani K and Kawazoe Y, "Introduction to Computational Materials Science from ab initio to Monte Carlo methods", Springer- Verlag, 1999.
4. Frenkel D and Smith B, "Understanding molecular simulation from algorithm to applications", Kluwer, Academic press, 1999.
5. Rabbe D, "Computational materials Science: The Simulation of Materials Microstructure and Properties", Wiley-VCH, 1998.

## 08O025 QUANTUM MECHANICS

**3 0 0 3**

**THE PHYSICAL BASIS OF QUANTUM MECHANICS:** Experimental background – the uncertainty principle – wave packets. Schrodinger wave equation, time dependent and time independent equations, interpretation of the wave function and its normalisation, probability current density, expectation values of dynamical variables, operators corresponding to dynamical variables and their postulates – eigen functions and eigen values of operators. (8)

**VECTOR SPACES AND LINEAR OPERATORS:** Representation of operators by matrix-adjoint of an operator – Hermitian operator, unitary operator, similarity transformation, Dirac's Bra and Ket notation. Heisenberg's representation of equation of motion. Matrix theory of Harmonic Oscillator. (7)

**HYDROGEN ATOM:** Schrodinger equation for Hydrogen like atoms and its solution (rigorous derivation is not included). Discussions of energy eigen values, the hydrogen orbitals and quantum numbers. (5)

**ANGULAR MOMENTUM:** Orbital angular momentum, spin angular momentum operators and their properties with eigen values and eigen functions. (5)

**APPROXIMATION METHODS:** Perturbation method – time independent perturbation of non-degenerate and degenerate cases. First order correction, applications. Stark effect and Zeeman effect of Hydrogen atom – harmonic oscillator, helium atom. (7)

**VARIATION METHOD:** Principles of the variation method for ground state with proof. Application of variation method to He atom. Other simple examples. (4)

**TIME DEPENDENT PERTURBATION THEORY:** First order correction – interaction between electromagnetic wave and atoms – transition probabilities – Einstein's coefficients – selection rules for harmonic oscillator and hydrogen atom (rigorous derivation not included). (6)

**Total 42**

**REFERENCES:**

1. Amit Goswami, "Quantum Mechanics", WCB Publishers, 1992.
2. Rajput Pragati Prakashan B S, "Advanced Quantum Mechanics", 1990.
3. Kakani and Chandalia, "Quantum Mechanics", Sultan Chand & Sons, 1980.
4. Schiff L I, "Quantum Mechanics", McGraw Hill Book Co., 1975.
5. Ghatak and Lokanathan, "Quantum Mechanics", The MacMillan Co., of India Ltd 1975.
6. Coulson ELBS and Oxford University Press, "Valence", 1969.
7. John C Slater, "Quantum Theory of Molecules and Solids" (Vol.I), McGraw Hill Book Co., 1965.

## 08O026 ELECTRO OPTIC MATERIALS

**3 0 0 3**

**BASICS OF LASER:** Laser beam characteristics, modes, noise, types of solid lasers (brief). (5)

**FUNDAMENTALS OF CRYSTALLOGRAPHY:** Symmetry operations and symmetry elements, point groups, tensor properties, dielectric description of a crystal, crystal structure of KDP, BaTiO<sub>3</sub> and LiNbO<sub>3</sub>. (6)

**PROPAGATION OF ELECTROMAGNETIC WAVES:** Anisotropic media - index ellipsoid, propagation in uniaxial crystals, Birefringence, wave plates and compensators, optical activity. (5)

**MATERIALS SELECTION FOR ELECTRO-OPTIC AND ACOUSTO-OPTIC DEVICES:** Growth of single crystals - Czochralski, Bridgmann and Zone refining techniques. (4)

**ELECTRO-OPTIC EFFECT:** E-O effect in KDP E-O retardation, E-O modulation - longitudinal and transverse E-O effect in cubic crystals, E-O Q- switching (Experimental) Beam deflectors. (6)

**ACOUSTO-OPTIC AND ELASTO-OPTIC EFFECTS:** Materials and devices based on these effects - modulators. (4)

**NON LINEAR PHENOMENA:** SHG, mode locking and frequency mixing - materials and devices. (5)

**NON LINEAR OPTICAL MATERIALS AND DEVICES:** Semiconductors - measurement of third order optical non-linearities in semiconductors. Optical switching devices employing optical non-linearities in semiconductors. Glasses - origin of non-linearity in glasses - SHG. (5)

**MOLECULAR CRYSTALS:** Growth of molecular crystals by temperature difference method. Liquid crystal E-O devices (brief). (2)

**Total 42**

**REFERENCES:**

1. Munn R W (Ed) and Irons C N, "Non Linear Optical Materials", Blackie Academic & Professional, Glasgow, 1993.
2. Kochner W, "Solid State Laser Engineering", Springer-Verlag, New York, 1976.
3. Yariv A, "Quantum Electronics", John Wiley & Sons, 1975.
4. Ivan P Kaminov, "An Introduction to Electro-Optic Devices", Academic press, New York, 1974.

## 08O027 ANALYTICAL METHODS IN MATERIALS SCIENCE

**3 0 0 3**

**CRYSTAL STRUCTURE:** Lattice directions and planes - Miller indices - Stereographic projection - Wulff net- Measurement of angle between poles - determination of Miller indices of an unknown pole. X-ray diffraction, Bragg's law, direction of diffracted beam. Diffraction under nonideal conditions - Scherrer formula for estimation of particle size. (5)

**X-RAY DIFFRACTION METHODS:** Laue method, rotating crystal method, powder method, Debye-Scherrer camera. Intensity of diffracted beams, scattering by an electron; scattering by an atom; scattering by a unit cell - structure factor - Structure factor calculations. (7)

**SURFACE STUDY:** The need for surface study. Surface chemical composition: The extension of bulk techniques to surface studies - Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Quadrapole mass spectrometer. Special surface techniques: Electron spectroscopy for chemical analysis (ESCA), ultraviolet photo electron spectroscopy (UPS), X ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES), Electron energy analysers, Laser Raman Spectroscopy, Secondary ion mass spectrometry, mass spectrometer types - Applications. (7)

**SURFACE STRUCTURE AND SURFACE STRUCTURE ANALYSIS:** Unit meshes of five types of surface nets - diffraction from diperiodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED), Scanning Probe microscope. (7)

**ELECTRON BEAM TECHNIQUES:** Transmission electron Microscopy (TEM), Scanning Transmission Electron Microscopy (STEM). Ion Beam Techniques: Rutherford Backscattering Spectrometry (RBS), Field Ion Microscopy (FIM). (7)

**ADVANCED MICROSCOPIC TECHNIQUES:** Scanning Tunnelling Microscopy, Constant current and constant height - mode - Instrumentation - Atomic Force Microscopy, Imaging modes, Force sensor, Deflection detection. (4)

**THERMAL ANALYTICAL TECHNIQUES:** Principles of differential thermal analysis, differential scanning calorimetry and thermogravimetric analysis - Instrumentation - determination of transition temperature, heats of transition of plastics, metals and alloys and other materials. (5)

**Total 42**

**REFERENCES:**

1. Treatise on Materials Science and Technology, Volume 27, "Analytical techniques for thin films", Academic Press, Inc., New York, 1991.
2. Prutton M, "Surface Physics", Clarendon Press Oxford, 1975.
3. Rodriguez F, "Principles of Polymer Systems", Tata McGraw Hill Co., 1974.
4. Edward A Colline, Jan Bares and Fred W Billmeyer, "Experiments in Polymer science", Jr Wiley - Interscience, 1973.
5. Cullity Addison B D, "Elements of X-ray Diffraction", Wesley Publishing Co., 1967.
6. Bacon G E, "X- ray and Neutron Diffraction", Pergamon Press, 1966.
7. Rohert S Shankaland, "Atomic and Nuclear Physics", The Macmillan Co., New York 1960.

## 080028 VACUUM SCIENCE AND DEPOSITION TECHNIQUES

**3 0 0 3**

**ELEMENTS OF HIGH VACUUM SYSTEM:** Study of a system to produce high vacuum, pumping speed, conductance of an orifice and tube, losses in pumping speed and determination of pumping speed. (5)

**TYPES OF PUMPS:** Rotary pump, diffusion pump, ejector pump, turbo molecular pump, roots blower pump, getter ion pump, sputter ion pump, cryosorption pump, cryocondensation pump - working principle, construction, operation - pressure range, limitations and pumping characteristics. (8)

**PROBLEMS CONNECTED WITH HIGH VACUUM:** Outgassing of materials - real and virtual leaks - methods of leak detection - sealing substance outside and pressure change inside - rate of pressure rise method - halogen leak detector and the helium leak detector. (7)

**VACUUM COMPONENTS:** Baffles and traps: Some designs of baffles, inline trap, right angle trap, dished trap, re-entrant trap, spherical trap and sorption trap, pumping losses in baffles and traps (qualitative). Vacuum valves: Gate valve, disc valve, flap valve, globe valve, needle valve and diaphragm valve. Some types of backable valves (Apart, Theorres and Nier tange valve). Vacuum seals: Common seals using elastomers, sliding and rotating seals, electrical lead and through. (9)

**VACUUM MEASUREMENTS: Primary gauges:** Viscosity gauge, radiometer type gauge, Mcleod gauge with construction and working principle. **Secondary gauges:** Pirani gauge, thermocouple gauge, thermionic ionization gauge, cold cathode ionisation gauge (Penning gauge) - working principle, construction and operation limits. (7)

**ULTRA HIGH VACUUM GAUGES:** X-ray limit of ionisation gauges, Baird Albert gauge, Klopfer gauge, Helmer gauge, Lafferty gauge, Red head gauge. (3)

**MATERIALS USED IN VACUUM SYSTEM:** Metals and their alloys, elastomer, glasses, ceramics, vacuum greases, oils, cements and waxes, drying and sorption agents. (3)

**Total 42**

**REFERENCES:**

1. Pipko A, et al, "Fundamentals of Vacuum Techniques", Mir publishers, 1987.
2. Leon I Maissel and Reinard Glang, "Hand Book of Thin Film Technology", McGraw Hill, 1970.
3. Green G L, "Design and Construction of Small Vacuum System", Chapman and Hall Ltd, 1968.
4. Dennis N T M and Heppel T A, "Vacuum Systems Design", Chapman and Hall Ltd., 1968.
5. Albert E Barrington, "High Vacuum Engineering", Prentice Hall, 1964.
6. Andrew Guthrie, "Vacuum Technology", John Wiley, 1963.
7. Davy J R, "Industrial High Vacuum", Sir Isaac Pitman and Sons, 1963.

## 08O029 SEMICONDUCTING MATERIALS AND DEVICES

3 0 0 3

**PROPERTIES OF SEMICONDUCTORS:** Density of states for a 3 dimensional system and in sub 3 dimensional system – Holes in semiconductors, Band structures of some semiconductors. Modification of band structure by alloying and by hetero structures. Quantum well structures, Intrinsic carrier concentration, Defect levels in semiconductors. (10)

**DOPING AND CARRIER TRANSPORT:** Doping: Extrinsic carrier density – Heavily doped semiconductors – Modulation doping (MODFET) – Transport: Scattering of electrons – Photon and ionised impurity scattering – Low field and high field transport in Si and GaAs – Transport of holes – Very high field transport: Break down phenomena – Avalanche break down (APD) – Carrier transport by diffusion. (10)

**P N JUNCTIONS AND BIPOLAR JUNCTIONS TRANSISTORS:** P-N junction under bias: Charge injection and current flow – Minority and majority currents – AC response of the p-n diode – Small signal equivalent circuit of a diode – BJT: minority carrier profiles – current components and current gain – Ebers – Moll model – Operating point and small signal equivalent circuits – BJT's in integrated circuits – Heterojunction BJT's – Microwave transistor – Qualitative operation of the JFET and MOSFET. (12)

**OPTO ELECTRONIC DETECTORS AND LASER DIODES:** Optical absorption in a semiconductor, Materials for optical detectors, Photo current in a p-n diode, Solar cell, Avalanche photo detector, Photo transistor, Quantum well inter subband detector. Laser diode, the laser structure, the optical cavity, optical absorption, Loss and gain, Laser below and above threshold. Advanced structures, Double hetero structure laser, Quantum well lasers, Quantum wire and quantum dot lasers. (10)

Total 42

### REFERENCES:

1. Sze S M, "Physics of Semiconductor Devices", John Wiley and Sons, 2001.
2. Kevin F Brennan, "The Physics of Semiconductors", Cambridge University Press, 1999.
3. Micheal Shur, "Physics of Semiconductor Devices", Prentice Hall of India, 1999.
4. Jasprit Singh, "Semiconductor Optoelectronics Physics and Technology", McGraw Hill Co., 1998.

## 08O030 SENSORS FOR ENGINEERING APPLICATIONS

3 0 0 3

**STRAIN AND PRESSURE MEASUREMENT:** Resistance strain gauge, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications. (9)

**MOTION SENSORS:** Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders. (8)

**LIGHT RADIATION:** Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state ,transducers liquid crystal devices. (9)

**HEAT AND TEMPERATURE:** Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector. (8)

**ELECTRONIC SENSORS:** Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors. (8)

Total 42

### REFERENCES:

1. Poebelin, E O, "Measurement Systems, Application and Design" , McGraw Hill, Fifth Edition, 2004
2. Jack P Holman, "Experimental Methods for Engineers", Seventh Edition, McGraw Hill, USA, 2001.
3. Ian R Sinclair, "Sensors and Transducers", Third Edition, Newnes publishers, 2001.
4. Robert G Seippel, "Transducers, Sensors and Detectors", Reston Publishing Company, USA, 1983.

## CHEMISTRY

### 08O031 ENERGY STORING DEVICES AND FUEL CELLS

3 0 0 3

**BATTERY CHARACTERISTICS:** Voltage, current, capacity, electricity storage density, power, discharge rate, cycle life, energy efficiency, shelf life. (5)

**PRIMARY BATTERIES:** The chemistry, fabrication, performance aspects, packing and rating of zinc-carbon, magnesium, alkaline, manganous dioxide, mercuric oxide, silver oxide batteries, zinc/air and lithium button cells- solid electrolyte cells. (5)

**SECONDARY BATTERIES:** The chemistry, fabrication and performance aspects and rating of lead acid and valve regulated (sealed) lead acid, nickel-cadmium, nickel-zinc, lithium and lithium ion batteries - Rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, thermal batteries. (6)

**BATTERIES FOR ELECTRIC VEHICLES:** Metal/air, zinc-bromine, sodium-beta alumina and lithium/iron sulphide batteries (outline only). Photogalvanic cells. Battery specifications for cars, heart pacemakers, computer standby supplies etc. (5)

**FUEL CELLS:** Introduction – relevance, importance and classification of fuel cells. Background theory - thermodynamic aspects of electrochemistry-energy conversion and its efficiency – factors affecting the efficiency, electrode kinetics of electrochemical energy conversion. (6)

**TYPES OF FUEL CELLS:** Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Proton Exchange Membrane fuel cells - basic aspects – working and high temperature operation – recent development in technology. (6)

**HYDROGEN AS FUEL:** Sources of hydrogen and preparation – clean up and storage – use as fuel in cells. (3)

**SOLAR CELLS:** Energy conversion devices, photovoltaic and photo electrochemical cells – photo biochemical conversion cell. (3)

**ENERGY AND ENVIRONMENT:** Future prospects-renewable energy and efficiency of renewable fuels – economy of hydrogen energy – life cycle assessment of fuel cell systems (3)

**Total 42**

#### TEXT BOOKS:

1. Aulice Scibioh M and Viswanathan B, "Fuel Cells – Principles and Applications", University Press (India), 2006
2. Barbir F, "PEM fuel cells: theory and practice" Elsevier, Burlington, MA 2005.
3. Dell, Ronald M R and, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001.
4. Pletcher D and Walsh C, "Industrial Electrochemistry", Blackie Academic and Professional, 1993.

#### REFERENCES:

1. Christopher M A Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, 2004.
2. Newman J S and Thomas -Alyea K.E. "Electrochemical systems" Third edition, Wiley, Hoboken, NJ 2004.
3. Hoogers G (Ed), "Fuel cell handbook" CRC, Boca Raton, FL 2003
4. Lindon David, "Handbook of Batteries", McGraw Hill, 2002

### 08O032 POLYMERS IN ELECTRONICS

3 0 0 3

**POLYMERIC MATERIALS:** Introduction – Origin, classification, formation of polymers – chain growth and step growth polymerization, copolymerization. Thermoplastics and thermosets. Micro structures in polymers – polymer length, molecular weight, amorphous and crystalline, thermal transitions in plastics. (8)

**IC FABRICATION PROCESSES:** Starting material processes – Silica purification, ingot growth, wafer generation. Imaging processes – pretreatment, coating, softbaking, exposure, development. Deposition and Growth processes – Oxidation, epitaxy, diffusion, ion implantation, metallization, chemical-vapor deposition. Etching and Masking processes – Undoped silicon dioxide etching, doped silicon dioxide etching, polysilicon etching, silicon nitride etching, Aluminium etching, metal lift-off, polyimide etching, resist implant masking, photomask etching. (10)

**PHOTORESISTS:** Chemistry and types of photoresists – Synthetic photopolymers – Photochemistry of crosslinking – Wafer processable photoresists – Resist processing – Development of crosslinking resists. (6)

**ELECTRONICALLY CONDUCTING POLYMERS:** General description – Band theory, insulators, semiconductors, metals, semimetals, poly(sulfur nitride), polyacetylene – Synthesis, structure and morphology. Conductivity doping, theory, uses. Phenylene polymers – poly(para-phenylene), poly(phenylene vinylenes), poly(phenylene sulfide). Polypyrrole and Polythiophene, Polyaniline. Stacked phtalocyanine polymers, polymers with transition metals in the side-group structure. (10)

**PRINCIPLES OF OPTICAL LITHOGRAPHY:** Introduction – Generalized Photolithographic systems. Optical exposure techniques – contact proximity printing, projection printing. Photoresists and substrates – General properties of photoresists, optical properties of positive photoresists, the wafer substrate, substrate topography, multilayer resist technology. Characterisation of lithographic image. (8)

**Total 42**

**TEXT BOOKS:**

1. David J Elliot, "Integrated Circuit Fabrication Technology", McGraw-Hill Book Company, USA, 1982.
2. Norman G Einspruch, "VLSI Electronics Microstructure Science", Volume 1, Academic Press, New York, 1981.

**REFERENCES:**

1. Harry R Allcock, Frederick W Lampe and James E Mark, "Contemporary Polymer Chemistry", 3<sup>rd</sup> edition, Pearson Prentice Hall, 2005.
2. Arnost Reiser, "Photoreactive Polymers the Science and Technology of Resists", Wiley Interscience, New York, 1989.

## **080033 ORGANIC ELECTRONICS**

**3 0 0 3**

**INTRODUCTION TO ORGANIC ELECTRONIC MATERIALS:** Organic electronic materials – classification. Organic Thin-film transistor – architecture, operating mode, fabrication techniques, Structure - property relationships. Methods of improving performance – structural perfection, device architecture. Electrical and environmental stability – chemical effects on stability. Gate dielectrics on electrical functionality. (12)

**ADVANCED MATERIALS FOR ORGANIC ELECTRONICS:** Pentacene transistors - performance. Engineered pentacenes – Reversible functionalization – end-substituted derivatives, perfunctionalized pentacenes. Heteropentacenes. Semiconductors based on polythiophene and Indolo[3,2-*b*]carbazole – polydialkylterthiophenes, polydialkylquaterthiophenes, polythiophene nanoparticles, indocarbazole designs. (10)

**MANUFACTURE METHODS:** Production of substrates for organic electronics - Reel-to-reel Vacuum metallization. Organic vapor phase deposition – production of TFTs, OLED, organic photovoltaics. Micro- and nanofabrication techniques – thermal imaging, printing. Digital lithography for TFT fabrication, solution based printing. (10)

**DEVICES, APPLICATIONS AND PRODUCTS:** Transistors to Integrated circuits – fabrication and characterization of ICs. Non-rigid display – Roll-up Active-matrix displays design. Active –matrix Light-emitting displays – advantages over LCDs, fabrication process. Large-area detectors and sensors – future prospects. Organic semiconductor-based chemical sensors. (10)

**Total 42**

**TEXT BOOK:**

1. Hagen Klauk "Organic Electronics: Materials, Manufacturing, and Applications" Wiley-VCH 2006

## **080034 FUNCTIONAL COATINGS BY POLYMER MICRO ENCAPSULATION**

**3 0 0 3**

**SUITABILITY OF TEXTILES:** Textile reactive sites – cellulose, protein, amide, acrylonitrile, ester, urethane, Linkages – ionic, covalent, co-ordinate, vander Waals' – Absorption and adsorption – Glass transition temperature and properties. (9)

**CHEMICALS AND POLYMERS FOR DEPOSITS:** Titanium oxide, zinc oxide, carbon black, barium sulphate – polyamine, polystyrene, polyalcohol, polyester, polyurethane – eco parameters, surface tension and surface active compounds. (8)

**APPLICATION METHODS:** Selection of methods for suitable fabric – deposition and reaction type – resin finishing, silicone finishing, emulsion finishing, enzyme finishing – mechanism of durable finishing – heat setting, chemical and electrochemical theory – colloidal theory, solid solution theory. (9)

**EFFECT OF TECHNIQUES:** Finishing effect – UV protection, stain repellent, anti static, flame retardant, water repellent/water proof, anti microbial. (8)

**QUALITY ASSESSMENT:** Assessment for durability, strength, softness, stiffness – hydrophilic and hydrophobic character – Suitable testing methods. (8)

**Total 42**

**TEXT BOOKS:**

1. Palmer John W, "Textile Processing and Finishing Aids' Recent Advance", Mahajan Book Distributors, 1996.
2. Peter R H, "Textile Chemistry – Vol – III", The Physical Chemistry of Dyeing, Elsevier, 1975.

**REFERENCES:**

1. Perkins W S, "Textile Colouration and Finishing", Carolina Academic Press, UK, 1996,
2. Pradip V Mehta, "An Introduction to Quality Control for the Apparel Industry", ASQC Quality Press, NY, 1992.
3. Chaplin and Bucke, "Enzyme Technology", Cambridge university Press, Cambridge, 1990.



## 08O035 ANALYTICAL METHODS FOR TEXTILES AND TEXTILE ANCILLARIES

3 0 0 3

**MOLECULAR WEIGHT DETERMINATION:** Number Average, Weight Average, Viscosity average molecular weights. Methods of determination of molecular weight for original and suitably chemical treated textiles. (8)

**QUALITATIVE ANALYSIS:** Identification of textile polymers – confirmation of different groups in the textile polymers – cellulose, protein, amide, ester – methods of analysis, Fastness characters of different dyes – Investigation of dyes. (6)

**QUANTITATIVE ANALYSIS:** Analysis of textile polymers in blends – chemicals for different polymers, methods – Density gradient method, solvent method, X-ray method. (6)

**MICROSCOPIC, AND X-RAY STUDY:** Projection microscopes, Scanning Electron Microscope, X-ray diffraction- Assessment of alignment, morphology, phases and differences that arise during treatments. (8)

**SPECTROSCOPIC STUDIES:** UV-VIS, FTIR and NMR spectroscopic studies. (8)

**QUALITY STUDY:** Efficiency of achievement in quality using various suitable chemical treatments – scouring, mercerising, dyeing, printing and finishing, cleaning by wet and solvent methods – Stain removal. (6)

**Total 42**

### TEXT BOOKS:

1. Venkataraman K, "The Chemistry of synthetic Dyes – Vol. I & II, Academic Press, New York, 1990
2. Willard H H, Meritt L L, Dean J A and Settle F A, "Instrumental Methods of Analysis" CBS Publishers and Distributors, New Delhi, 1986.
3. Shenai V A, "Evaluation of Textile Chemicals" Sevak Publications, Mumbai, 1980.

### REFERENCES:

1. Skoog D A, Holler F J and Nieman TA, "Principles of Instrumental Analysis", Harcourt Brace College Publishing, FI, 1998.
2. Mukhopadhyay S K, "Advances in Fiber Science", The Textile Institute, UK, 1992.
3. McLaren K, "The Colour Science of Dyes and Pigments", Adam – Hilger, Bristol, UK, 1983.
4. ISI Hand book of Textile Testing, Indian Standards Institution, New Delhi, 1982.

## 08O036 POLYMERS AND COMPOSITES

3 0 0 3

**OVERVIEW:** Introduction – Definitions and classification – Matrix at reinforcements – Factors determining properties – benefits of composites. (5)

**REINFORCEMENTS AND REINFORCEMENT–MATRIX INTERFACE:** Natural, synthetic organic and inorganic fibres – particulate and whisker reinforcements – reinforcement matrix interface. Production, chemistry and properties of glass fibre, asbestos, boron, high silica and quartz fibers. (6)

**MATRIX MATERIALS:** Manufacturing, chemistry, properties, curing and suitable reinforcing materials for polyester resins, epoxy resins, phenolic and silicones. High temperature resistant polymers. (5)

**PROCESSING METHODS: Hand lay-up techniques:** Simple and complex, spray-up, wet lay-up low compression molding, moldless lay-ups. Structural laminate bag molding, reinforced molding compounds, prepregs, filament winding. (6)

**TESTING OF COMPOSITES:** Tension, flexure, interlaminar shear, compression with sandwich beam tests. (3)

**NON-DESTRUCTIVE TESTS:** Ultrasonic inspection, radiography, vibration and thermal methods, acoustic emission. (3)

**POLYMER NANOCOMPOSITES:** Classification, nanosized additives, advantages. Clay containing polymeric nanocomposites, polyolefine nanocomposites, polymer silicate nanocomposite via melt – Applications of nanocomposites. (6)

**APPLICATION OF POLYMER COMPOSITES:** Polymer-matrix composites with continuous and discontinuous fillers application in electrical, electromagnetic, thermoelectric, dielectric, optical applications. Polymer composite for biomedical and vibration damping. (8)

**Total 42**

### TEXT BOOKS:

1. Deborah Chung D L, "Composite Materials: Science and Applications", Springer International, USA, 2004.
2. Matthews F L and Rawlings R D, "Composite Materials: Engineering and Science", Woodhead Publishers, England, 1999.

### REFERENCES:

1. Parag Diwan and Ashish Bharadwaj, "Nano Composites", Pentagon Press, India, 2006.
2. George Lubin, "Handbook of Fiberglass and Advanced Plastics Composites", Van Nostrand Reinhold Company, New York, 1969

## 080037 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

**THERMODYNAMICS OF AQUEOUS CORROSION:** Electrode processes – electrode potential, free energy, emf series, potential measurements, computation and construction of Pourbaix diagrams of Fe, Al, practical use of E-pH diagrams. Chemical Vs electrochemical mechanisms of corrosion reactions, corrosion rate expressions. (7)

**KINETICS OF AQUEOUS CORROSION:** Corrosion current density and corrosion rate, exchange current density, polarization - activation control, Tafel equation, concentration polarisation, mixed potential theory, combined polarization. Passivity-potentiostatic polarization curves, factors affecting passivity, mechanism of action of passivators. (7)

**FACTORS AFFECTING AQUEOUS CORROSION:** Effect of environmental variable - effect of pH, oxidation potential, temperature, velocity/fluid flow rate, concentration, biological effects. Effect of metallurgical variables - metals and their surfaces, alloys and their surfaces, effect of alloying on corrosion resistance, effect of heat treatment. (5)

**FORMS OF CORROSION:** General corrosion - atmospheric corrosion, galvanic corrosion, general biological corrosion. Localised corrosion - filiform corrosion, crevice corrosion, pitting corrosion, localized biological corrosion. Metallurgically influenced corrosion-inter granular corrosion, de-alloying. Mechanically assisted corrosion - erosion corrosion, fretting corrosion, corrosion fatigue. Environmentally induced cracking – mechanisms of stress corrosion cracking and hydrogen embrittlement. (8)

**PREVENTION AND CONTROL OF CORROSION:** Corrosion control by design. Selection of corrosion resistant materials – alloying, stainless steel and brass. Oxidation resistant materials, control of high temperature oxidation. Cathodic and anodic protection methods. Use of inhibitors-types, applications. Corrosion in cold water pipes - Langalier saturation index. (6)

**CORROSION MONITORING:** Introduction - On-stream monitoring – Electrical resistance, linear polarization, hydrogen test probe, ultrasonic testing, radiography and corrosion coupons. Off-stream monitoring equipments – Acoustic emission testing, eddy current inspection, liquid penetration inspection. (5)

**CORROSION TESTING:** Purpose and classification. Dimensional change - Ultrasonic thickness measurements, eddy current, microscopic examination. Weight change – Specimen preparation, test conditions and evaluation of results for overall corrosion, SCC, IGC. Electrochemical techniques – Polarization curves, Tafel extrapolation, linear polarization, AC impedance methods (EIS). (4)

Total 42

### TEXT BOOKS:

1. Kenneth R Trethewey and John Chamberlain, "Corrosion – For science and engineering", Second edition, Longman Inc., 1996.
2. Rajnarayan, "Metallic corrosion and prevention", Oxford Publications, 1988.
3. Mars G Fontana, "Corrosion Engineering", Third Edition, Mc Graw Hill Inc., 1987.
4. Herbert H Uhlig and Winston Revie R, "Corrosion and corrosion control – An introduction to corrosion science and Engineering", Third Edition, John Wiley & Sons, 1985.

### REFERENCES:

1. ASM hand book – Vol 13: Corrosion, ASM International, 2001.
2. Denny A Jones, "Principles and Prevention of Corrosion", Second Edition, Prentice Hall Inc., 1996
3. Philip A Schweitzer, "Corrosion and Corrosion Protection Handbook", USA, 1983.

## 080038 CHEMISTRY OF NANOMATERIALS

3 0 0 3

**SYNTHESIS OF NANOPARTICLES:** Introduction – hydrolysis-oxidation- thermolysis - metathesis-solvothermal methods.sonochemistry; nanometals-powers of metallic nano particles-metallic colloids &alloys -polymer metal composites-metallic oxides-rare earth oxides-mesoporous materials-mixed oxides. sono electro chemistry-nanocrystalline materials. micro wave heating-micro wave synthesis of nano metallic particles. (10)

**NLO PROPERTIES OF ORGANIC MATERIALS:** Basic concepts-Relationship between molecular structure and NLO properties - Materials design-organic crystals-Poled polymers, self assembled monolayer-Third order NLO materials – Chromophores for optical limiting (8)

**NANO POROUS SILICON AND ITS APPLICATIONS:** Introduction – Preparation and Characterization of porous silicon substrates – Surface chemistry of porous silicon surfaces – Chemical Applications Based on porous silicon – Bioactive porous silicon.

**NANOCATALYSIS:** Introduction – Chemical Reaction on point Defects of Oxide surfaces – Chemical Reactions and catalytic Processes on free and supported clusters. (8)

**NANOPOROUS MATERIALS:** Introduction – Stability of open-Framework Materials – Aluminosilicate Zeolites – Open-framework Metal Phosphates – Aluminum Phosphates – Phosphates of Gallium and Indium – Tin(II)Phosphates and Antimony (III)phosphates – Transition Metal Phosphates – Molybdenum and Vanadium phosphates – Iron phosphates (8)

**NANOPARTICLE AND NANOSTRUCTURED MATERIALS:** Preparation of Nanoparticle-metal particles: Thermal decomposition of metal carbonyls, semiconductors, Zeolites, inverse micelles, Gels, phosphates and polymers. Ceramic nano particles - sol-gel-Aerosols and Xerogels, precipitation and digestion. Physical and Chemical properties : Metallic behavior –

magnetic behavior –Binding energies and melting points –optical and electronic properties –NLO properties –metals and semiconductors. (8)

**Total 42**

**TEXT BOOK:**

1. Rao C N R, Muller A and Cheetham A K, "The Chemistry of Nano materials: Synthesis, Properties and Applications", Vol. 1 & 2, Wiley-VCH, 2004.

**REFERENCE:**

1. Interrante L V and Hampden-Smith M J,"Chemistry of Advanced Materials", Wiley -VCH, 1988.

## **08O039 POLYMER CHEMISTRY AND POLYMER PROCESSING**

**3 0 0 3**

**POLYMERIC MATERIALS:** Introduction – Origin, classification, formation of polymers – chain growth and step growth polymerization, copolymerization. Thermoplastics and thermosets. Micro structures in polymers – polymer length, molecular weight, amorphous and crystalline, thermal transitions in plastics. Physical basis of polymer processing – Liquids and viscosity, viscosity and polymer processing, shear stress in polymer system, non-newtonian flow, melt flow index. (10)

**MIXING:** Polymers and additives – Modifying and protective additives. Physical form of polymer mixes – Types of mixing – Machines for mixing – Twin drum tumbler, ribbon blender high speed mixer, ball mill, two roll mill, banbury mixer. (5)

**INJECTION AND EXTRUSION MOULDING:** Injection moulding – principle, equipment, material and product considerations, operations and control, special injection molding processes. Extrusion molding – principle, features of single screw extruder, flow mechanism, twin screw extruder, extruder and die characteristics. (7)

**BLOW MOLDING AND THERMOFORMING:** Principle – extrusion blow molding, injection blow molding, molds and dies, operation and control for blow molding. Thermoforming: Principle, equipment and product considerations, vacuum forming. (6)

**COMPRESSION AND TRANSFER MOLDING PROCESS:** Principle, thermosetting compounds, compression molding and transfer moulding, reaction injection molding cold forming, sintering and ram extrusion. (5)

**CASTING AND FOAMING PROCESS:** Casting process – equipment, product considerations, operation and control. Foaming process: Process to create foams in resins, processes to shape and solidify foams, foam insulation. (5)

**FIBER REINFORCED PLASTICS:** Materials, hand lay-up process, sheet moulding compound (SMC), dough moulding compound, process variants, mechanical strength of fiber reinforce plastics. (4)

**Total 42**

**TEXT BOOKS:**

1. Brent Strong A, "Plastics: Materials and processing", Prentice-Hall, New Jersey, 2000.
2. Morton-Jones D H, "Polymer Processing", Chapman and Hall, New York, 1989.

**REFERENCES:**

1. Brydson J A, "Plastic Materials", Butterworths, London.
2. Deborah D L Chung, "Composite Materials: Science and Applications", Springer International, USA, 2004.

## **08O040 ELECTROANALYTICAL METHODS**

**3 0 0 3**

**FUNDAMENTAL CONCEPTS:** Electroanalysis, faradaic processes, mass-transport-controlled reactions, potential-step experiment, potential-sweep experiments, rate of electron transfer, activated complex theory, electrical double layer, electrocapillary effect. (8)

**ELECTRODE REACTIONS AND INTERFACIAL PROPERTIES:** Cyclic voltammetry, reversible, irreversible and quasi-reversible systems, study of reaction mechanisms, adsorption processes, quantitative applications. Electrochemiluminescence. Scanning probe microscopy. Impedance spectroscopy. (10)

**CONTROLLED-POTENTIAL TECHNIQUES:** Chronoamperometry, polarography, pulse voltammetry, normal-pulse voltammetry, differential-pulse voltammetry, square-wave voltammetry, staircase voltammetry, ac voltammetry. Stripping analysis. (10)

**EXPERIMENTAL TECHNIQUES:** Construction of cells and instrumentation. Working electrodes and their types. Solvents and supporting electrolytes. (4)

**POTENTIOMETRY:** Principles of potentiometric measurements, Ion-selective electrodes - glass electrodes, pH electrodes, glass electrodes, liquid membrane electrodes, ion exchanger electrodes, neutral carrier electrodes and solid-state electrodes. (10)

**Total 42**

**REFERENCES:**

1. Joseph Wang, "Analytical Electrochemistry", Third edition, Wiley Interscience, 2006.
2. Jeffery G H, Bassett J, Mendham J and Denney R C, "Vogel's Text book of Quantitative Chemical Analysis", ELBS, Fifth edition, Longman, Singapore Publishers, Singapore, 1996.

**08O041 INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS****3 0 0 3**

**SEPARATION TECHNIQUES:** Chromatographic methods - principles, classification – Column chromatography, Liquid chromatography, Paper chromatography, HPLC, Thin layer chromatography, Ion-exchange chromatography, Gas chromatography, GC-Mass chromatography. Supercritical fluid chromatography; Capillary electrophoresis – principles, instrumentation and applications. (8)

**THERMAL METHODS OF ANALYSIS:** Thermal analytical techniques – TGA, DTA, DSC – principles, instrumentation and applications. (5)

**SPECTRAL METHODS:** Atomic absorption spectroscopy, Atomic emission spectroscopy, ICP-AES spectroscopy - principles, instrumentation and applications. Flame emission spectroscopy – Flame spectrophotometers, quantitative analysis by flame emission spectroscopy. Light scattering methods – nephelometry, turbidometry, Raman scattering – principles and applications. (10)

**UV-VIS SPECTROSCOPY:** Basics – types of transitions – Instrumentation – double beam UV-VIS spectrophotometer – Factors influencing  $\lambda_{max}$  – Woodward fieser rules –applications. (5)

**IR SPECTROSCOPY:** Basics - theory – Instrumentation – sample handling – working of double beam IR spectrophotometer – modes of vibrations – selection rules – factors influencing vibrational frequencies – interpretation of spectra – Finger print region – PQR branches – characteristic group frequencies – applications to organic and inorganic compounds – problems. Raman Spectroscopy: Basics – Stokes and antistokes lines – comparison of IR & Raman – mutual exclusion principle – applications. (6)

**MASS SPECTROMETRY:** Principles – Instrumentation – double focusing mass spectrometer – molecular ions – metastable ions – fragmentation pattern – McLafferty rearrangement – Retro diels alder reaction – determination of molecular weight – nitrogen rule – fragmentation in organic compounds. Mossbauer spectroscopy: Mossbauer nuclei – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine interactions – applications. (8)

**Total 42****TEXT BOOKS:**

1. Banwell C N and McCash E M, "Fundamentals of molecular spectroscopy", Fourth Edition, Tata McGraw Hill, New Delhi, 1995.
2. Kemp W, "Organic Spectroscopy", Third Edition, ELBS, McMillan, London, 1991.
3. Williams D H and Fleming I, "Spectroscopic Methods in Organic Chemistry", Fourth Edition, McGraw Hill, New York, 1989.

**REFERENCES:**

1. Pavia D L, Lampman G M and Kriz G S, "Introduction to Spectroscopy", Third Edition, Brooks/Cole Pub, Singapore, 2001.
2. Drago R, "Physical Methods for Chemists", Saunders, Philadelphia, 1992.
3. Pasto D, Johnson C and M.Miller, "Experiments and Techniques in Organic Chemistry", Prentice- Hall Inc., New Jersey, 1992.
4. Silverstein R M, Bassler G C and Morrill T C, "Spectrometric Identification of Organic Compounds", John Wiley, New York, 1991.

**08O042 ADVANCED REACTION MECHANISM****3 0 0 3**

**ADDITION REACTIONS:** Reactive intermediates – formation and stability of carbonium ions, carbanions, carbenes and carbenoids, nitrenes, radicals and arynes. Addition to carbon-carbon and carbon – hetero multiple bonds –electrophilic, nucleophilic and free radical additions - stereochemistry of addition to carbon-carbon multiple bonds- orientation and reactivity, addition to conjugated systems and orientation – addition to  $\alpha,\beta$  unsaturated carbonyl groups. (8)

**SUBSTITUTION REACTIONS:** Aliphatic nucleophilic substitutions – SN1, SN2 and SNi mechanisms- effects of substrate, attacking nucleophile, leaving group and solvent- stereochemistry of nucleophilic substitution reactions- substitutions at carbonyl, bridgehead, vinylic and allylic carbons- neighbouring group participation, norbornyl cation and other non-classical carbocations, ambident nucleophiles – O versus C alkylation. aromatic nucleophilic substitutions - mechanisms effects of substrate, structure, leaving group and attacking nucleophile. – various methods of benzyne generation and reactions of benzyne, reactions of aryl diazonium salts. Vicarious nucleophilic substitution (VNS), Chichibabin and Schiermann reactions - Aromatic electrophilic substitution reactions and mechanisms. (10)

**ELIMINATION REACTIONS:** E1, E2 and E1cB mechanisms – stereochemistry of E2 elimination – competition between elimination and substitution reactions – orientation effects in elimination reactions – effects of substrate structures, attacking base, leaving group and medium on E1 and E2 reactions – pyrolytic eliminations – Bredt's rule. (8)

**REARRANGEMENTS:** General mechanistic considerations, nature of migration, migratory aptitude - nucleophilic, electrophilic and free radical rearrangements – Wagner – Meerwein, McLafferty, Demyanov, Benzil-benzilic acid, Favorskii, Fritsch-Buttenberg-Wiechell, Neber, Hofmann, Curtius, Beckmann, Schmidt, Lossen, Wolff, Baeyer – Villiger, Stevens, Wittig, Chapman, Wallach, Orton, Bamberger, Pummerer and Von Richter rearrangements. (8)

**REAGENTS IN ORGANIC SYNTHESIS:** Diborane, lithium aluminium hydride, sodium borohydride, selenium dioxide, osmium tetroxide, phenyl isothiocyanate, NBS, dicyclohexylcarbodiimide(DCC), lead tetraacetate, pyridinium chlorochromate(PCC), Swern oxidation, p-toluenesulphonyl chloride, trifluoroacetic acid, lithium diisopropylamide (LDA), 1,3-dithiane (reactive umpolung), crown ethers, trimethyl silyl iodide, dichlorodicyanobenzoquinone (DDQ), Gilman's reagent, lithium dimethylcuprate, tri-n-butyltin hydride, di-tert-butoxy dicarbonate, dihydropyran, phase transfer catalysts, Wilkinson's catalysts, Peterson's synthesis, Merrifield resin and diethylaluminium cyanide. (8)

**Total 42**

**TEXT BOOKS:**

1. Finar I L, "Organic Chemistry", Vol. II, Fifth Edition, ELBS Longmann Group Ltd. London, 2001.
2. Francis A Carey and Richard J Sundberg, "Advanced Organic Chemistry", Part A and Part B, Third Edition, Plenum press, New York, 1993.
3. Lowry T H and Richardson K S, "Mechanism and theory in Organic Chemistry", Second Edition, Harper and Row Publishers, 1981.

**REFERENCES:**

1. Kalsi P S, "Organic reactions and their mechanisms", New Age International Publishers, New Delhi, 2006.
2. Jerry March, "Advanced Organic Chemistry", Fourth Edition, Wiley-Intersciences, New York, 2003.
3. Francis A Carey, "Organic Chemistry", Fifth Edition, Tata McGraw Hill, New Delhi, 2003.
4. Mackie and Smith, "Organic Synthesis", Second Edition, Longmann Group Ltd, London, 1990.

## 08O043 CHEMICAL SENSORS AND BIOSENSORS

**3 0 0 3**

**BIOSENSORS:** Introduction – amperometric enzyme electrodes-characteristics- enzyme activity determinations – biosensors from enzyme immunoassay – Potentiometric enzyme electrodes – electrode characteristics and performance –pH glass and ion-selective electrodes – solid-state pH and redox electrodes –gas electrodes. (7)

**IMMUNO BIOSENSORS:** Potentiometric immunobiosensors – immobilization techniques – analytical applications. Principle and measurements of enzyme thermistor devices. Transducer – experimental techniques – types of biological element: immobilized enzymes – immobilized cells – determination of enzyme activities in solution (7)

**CHEMICALLY MEDIATED FIBEROPTIC BIOSENSORS:** Introduction – sensing chemistry and materials –sensing techniques –transducer types. Transducer-based fiber optic biosensors – Optical biosensors based on competitive binding (6)

**REDOX HYDRO-GEL BASED ELECTROCHEMICAL BIOSENSORS:** Electron conducting redox polymer in biosensors – enzyme electrodes – specific sensor examples. Hybridization at oligonucleotide sensitive electrodes: function of oligonucleotide sensitive electrodes – hybridization efficiency and sensitivity – probe oligonucleotide structure and dynamics – hybridization conditions – hybridization kinetics. (8)

**FLUOROPHORE AND CHROMOPHORES BASED FIBEROPTIC BIOSENSORS:** Enzyme based nonmediated fiberoptic biosensors – chromophores and fluorophore detection. Bioluminescence and chemiluminescence based fiberoptic sensors – bioluminescence and chemiluminescent reactions – analytical potential of luminescent reactions – applications (7)

**DETERMINATION OF METAL IONS BY FLUORESCENCE ANISOTROPY:** Theory of anisotropy based determination of metal ions – fluorescent aryl sulfonamides for zinc determination- removal of zinc from carbonic anhydrase – determination of zinc using reagent approach – determination of copper and other ions by using reagentless approach. (7)

**Total 42**

**REFERENCES:**

1. Copper J M and Cass E G A, "Biosensors", Second Edition, Oxford University Press, 2004.
2. Blum L J and Coulet P R, "Biosensor Principles and Applications", Marcel Dekker Inc., 1991.

## 08O044 COMPUTATIONAL PHYSICAL CHEMISTRY

**3 0 0 3**

**REVIEW OF QUANTUM CHEMISTRY:** Planck's quantum theory, wave-particle duality – uncertainty principle, operators and commutation relations – postulates of quantum mechanics – Schrödinger equation: free particle, particle in a box – degeneracy, harmonic oscillator, rigid rotor and the hydrogen atom. Angular momentum, including spins, coupling of angular momentum including spin-orbit coupling. (8)

**FOUNDATIONS OF MOLECULAR ORBITAL THEORY:** The variation method – perturbation theory – application to helium atom – antisymmetry and exclusion principle – Slater determinantal wave equation – Born-Oppenheimer approximation – Hydrogen molecule ion – LCAO-MO and VB treatments of the hydrogen molecule – Electron density, forces and their role in chemical binding. Hybridization and valence MO'S of H<sub>2</sub>O, NH<sub>3</sub> and CH<sub>4</sub> – Huckel pi-electron theory and its applications to ethylene, butadiene and benzene – idea of self-consistent fields. (8)

**GROUP THEORY:** The concept of groups – classes – Abelian group – cyclic group – multiplication table. Symmetry elements and symmetry operations. Point group classification. Matrix representations and symmetry operations. Reducible and irreducible representation

Character tables for point groups : Orthogonality theorem. Properties of irreducible representation construction of character tables for point groups. The relationship between reducible and irreducible representation. Representations and vibrational modes in H<sub>2</sub>O, NH<sub>3</sub> and BF<sub>3</sub> molecules. (8)

**AB INITIO THEORY AND CHEMICAL APPLICATIONS:** Hartree theory – Hartree-Fock SCF method – electron correlation – Moller–Plesset theory – Basis set – functional forms – contracted Gaussians – single, multiple, split-valence – polarization function – diffuse functions – computation procedure for the solution of SCF equations – energy gradient – molecular geometry – conformation searching – solvent effect – molecular interactions. (7)

**DENSITY FUNCTIONAL THEORY:** Thomas-Fermi model – The Hohenberg-Kohn theorem – The Kohn-Sham equations – exchange–correlation potentials – chemical potential – Electronegativity – Global hardness and softness – local hardness and softness – Fukui functions – Sanderson's electronegativity equalization principle – Pearson's hard and soft acids and bases principle – the maximum hardness principle. (7)

**COMPUTER APPLICATIONS:** Coordinate specification – Z-matrix – Cartesian coordinates – Introduction to structure drawing – Hands on use of software packages – Gaussian; Gamess, Molden. (4)

**Total 42**

**TEXT BOOKS:**

1. Atkins P W and Friedman R S, "Molecular Quantum Mechanics", Oxford University Press, Newyork, 2001.
2. Helgaker T, Jorgensen and Oslen J, "Molecular Electronic Structure Theory", John Wiley, Newyork, 2000.
3. Ira N Levine, "Quantum Chemistry" Prentice Hall, 1991.
4. Gopinathan M S and Ramakrishnan V, "Group theory in Chemistry " Vishal Publishers, New Delhi, 1988.

**REFERENCES:**

1. Cramer C J, "Essentials of Computation Chemistry", Wiley, Chichester, 2002.
2. Leach A R, "Molecular Modelling – Principles and Applications", Prentice Hall, 2001.
3. Robert G Parr and Weitao yang, "Density Functional Theory of Atoms and Molecules", Oxford University press, Newyork, 1989.
4. Szabo A and Ostlund N S, "Modern Quantum Chemistry", McGraw Hill, Newyork, 1989.
5. Warren J Hehre, Leo Radom, Paulv R.Schleyer and John A Pople, "Ab initio Molecular Orbital Theory", John Wiley, Newyork, 1986.
6. Davidson G, 'Introductory group theory for chemistry' Applied Science Publications London 1971.

## 080045 MOLECULAR SPECTROSCOPY

**3 0 0 3**

**UV-VIS SPECTROSCOPY:** Basics – types of transitions – Instrumentation – double beam UV-VIS spectrophotometer – Factors influencing  $\lambda_{max}$  – Woodward fieser rules –applications. (6)

**IR SPECTROSCOPY:** Basics - theory – Instrumentation – sample handling – working of double beam IR spectrophotometer – modes of vibrations – selection rules – factors influencing vibrational frequencies – interpretation of spectra – Finger print region – PQR branches – characteristic group frequencies – applications to organic and inorganic compounds – problems. Raman Spectroscopy: Basics – Stokes and antistokes lines – comparison of IR & Raman – mutual exclusion principle – applications. (10)

**MASS SPECTROMETRY:** Principles – Instrumentation – double focusing mass spectrometer – molecular ions – metastable ions – fragmentation pattern – McLafferty rearrangement – Retro diels alder reaction – determination of molecular weight – nitrogen rule – fragmentation in organic compounds.

Mossbauer spectroscopy: Mossbauer nuclei – Doppler effect – isomer shift – quadrupole splitting – magnetic hyperfine interactions – applications. (12)

**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:** Proton magnetic resonance – theory – relaxation processes – chemical shift – factors affecting chemical shift – spin-spin coupling – coupling constants – first order splitting patterns and second order effects on spectrum – AMX, ABX and ABC systems – Nuclear overhauser effect – Double resonance – <sup>13</sup>C NMR spectra – theory – chemical shifts and correlations. (10)

**ELECTRON SPIN RESONANCE SPECTROSCOPY:** Principle – factors affecting the intensity – hyperfine splitting – g values and their significance – application to simple systems. (4)

**Total 42**

**TEXT BOOKS:**

1. Banwell C N and McCash E M, "Fundamentals of molecular spectroscopy", Fourth Edition, Tata McGraw Hill, New Delhi, 1995.
2. Kemp W, "Organic Spectroscopy", Third Edition, ELBS, McMillan, London, 1991.

## REFERENCES

1. Pavia D L, Lampman G M and Kriz G S, "Introduction to Spectroscopy", Third Edition. Brooks/Cole Pub, Singapore, 2001.
2. Pasto D, Johnson C and Miller M, "Experiments and techniques in Organic Chemistry", Prentice- Hall Inc., New Jersey, 1992.
3. Drago R, "Physical Methods for Chemists", Saunders, Philadelphia, 1992.
4. Silverstein R M, Bassler G C and Morrill T C, "Spectrometric Identification of Organic Compounds", John Wiley, New York, 1991.
5. Williams D H and Fleming I, "Spectroscopic Methods in Organic Chemistry", Fourth Edition, McGraw Hill, New York, 1989.

## HUMANITIES

### 080046 PRINCIPLES OF MANAGEMENT

3 0 0 3

**PRINCIPLES OF MANAGEMENT:** Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. Engineers and Organizational Environment – Social, Economic, Technological and Political. Social Responsibility of Engineers. (5)

**MANAGEMENT CONCEPTS:** MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM. (5)

**BUSINESS PROCESS REENGINEERING:** Need for BPR, Various phases of BPR, Production and Productivity – Factors Influencing Productivity. (4)

**ORGANIZATIONAL BEHAVIOUR:** Significance of OB, Role of leadership, Personality and Motivation. Attitudes, Values and Perceptions at work. (5)

**INDUSTRIAL AND BUSINESS ORGANIZATION:** Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (5)

**MATERIALS MANAGEMENT:** Importance and Scope of Materials Management, Purchase Procedure, Inventory Control and Systems for Inventory Control – ROL, EOQ, MRP, ABC Analysis, VED, FSN and Value Analysis. (4)

**MARKETING MANAGEMENT:** Definition and Approaches to Marketing Management – Marketing Environment. The Marketing Process. Marketing Mix, Advertising, Sales Promotion and Consumer Behaviour. (4)

**HUMAN RESOURCE MANAGEMENT:** Importance, Objectives and Functions, Job Analysis and Recruitment, Selection and Placement, Training and Development – Case Discussion. (4)

**JOB EVALUATION:** Meaning and Methods of Job Evaluation. Performance Appraisal – Meaning and Methods of Performance Appraisal. (3)

**WELFARE IN INDUSTRY:** Working condition, service facilities, legal legislation – Factories Act, 1948 and Workmen's Compensation Act. (3)

**Total 42**

#### TEXT BOOKS:

1. Harold Koontz, Heinz Weihrich and Ramachandra Aryasri, "Principles of Management" - Tata McGraw Hill, New Delhi, 2004.
2. Mamoria C B, "Personnel Management", Sultan Chand & Sons, New Delhi, 2002.

#### REFERENCES:

1. Philip Kotler, "Marketing Management", Pearson Education Asia, New Delhi, 2003.
2. Khanna O P, "Industrial Engineering & Management", Dhanpat Rai Publications, New Delhi, 2003.
3. John W Newstrom, Keith Davis, "Organizational Behavior", Tata McGraw Hill, New Delhi, 2002.

### 080047 HUMAN RESOURCE MANAGEMENT

3 0 0 3

**NATURE AND SCOPE OF HUMAN RESOURCE MANAGEMENT:** Meaning and Definition of HRM, Objectives and Functions of HRM, Models of HRM, HRM in a changing Environment, Role of Globalization in Human Resource Management. (4)

**HUMAN RESOURCE PLANNING:** Job analysis – Job Specification – Recruitment – Induction – Selection – Placement: Role in HRM, Process, Methods, use of Tests in Selection and Placement. (5)

**WAGE AND SALARY ADMINISTRATION:** Principles and Techniques of Wage Fixation, Job Evaluation, Incentive Schemes. (4)

**PERFORMANCE APPRAISAL:** Process, Methods, Factors that distort appraisal, Methods to Improve Performance, Role of Performance in the Performance Management Process, Performance Appraisal Vs. Potential Appraisal. (5)

**TRAINING AND DEVELOPMENT:** Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives. (4)

**MORALE AND MOTIVATION OF EMPLOYEES:** Morale-importance of Moral-employee Attitudes and Behaviour and their significance to Employee Productivity. Motivation Methods of Employees, Empowerment – Factors Affecting Empowerment – Process – Benefits. (4)

**WORK ENVIRONMENT AND TERMS AND CONDITIONS OF EMPLOYMENT:** Fatigue – Safety – Accident Prevention Accident Records – Industrial Relations. (4)

**INTERNATIONAL HRM:** Model, Variables that outline difference between local and International HRM approaches to IHRM, Linking HRM to International Expansion Strategies. (5)

**TRENDS IN HR:** HR Outsourcing – HRIS – Management of Turnover and retention – Workforce Relationlization – Managing Separation – Trends in Employee Engagement and Retention. (7)

**Total 42**

**TEXT BOOK:**

1. Gary Dessler, "Human Resource Management", Prentice Hall of India, New Delhi, 2003.

**REFERENCES:**

1. Bernardin H and John, "Human Resource Management – An experiential Approach", Tata McGraw Hill, 2004.
2. Cascio H and Wayne, "Managing Human Resources – Productivity, Quality of Work Life and Profits, Tata McGraw Hill, 2004.
3. Dezenzo A David and Robbins P Robbins, "Human Resource Management", John Wiley and Sons, Inc, MA., 2002.
4. Aswathappa K, "Human Resource and Personnel Management – Text and Cases", Tata McGraw Hill, 2002.

## **080048 INTRODUCTION TO MANAGEMENT**

**3 0 0 3**

**INTRODUCTION:** An Introduction to Management – The Management Process – Managerial Roles – Managerial Skills – the Science and Art of Management – Becoming a Manager. (4)

**THE ENVIRONMENTAL CONTEXT OF MANAGEMENT:** The Organization's Environments – The External Environment – The General Environment – The Internal Environment – The Organization's Culture (its importance, determinants and management), Models of Organizational Effectiveness. (4)

**THE ETHICAL AND SOCIAL ENVIRONMENT:** Ethical Behavior - Social Responsibility and Organizations (Areas, arguments for and against – Including Approaches to Social Responsibility – The Government and Social Responsibility – Evaluating Social Responsibility. (5)

**THE GLOBAL ENVIRONMENT:** The Nature or International Business – The meaning of International Business – Trends in International Business – The Cultural Environment. (4)

**PLANNING AND DECISION MAKING:** The Decision Making and Planning Process – Organizational Goals – Organizational Planning – Contingency Planning and Crisis Management – Barriers to Goal Setting and Planning – Overcoming the barriers – Using Goals to Implement Plans. (4)

**THE NATURE OF STRATEGIC MANAGEMENT:** The Components of Strategy – Types of Strategic Alternatives – Strategy Formulation and Implementation – Using SWOT Analysis to Formulate Strategy – Porter's Generic Strategies – Implementing Porter's Generic Strategies. (4)

**BASIC ELEMENTS OF ORGNIZING:** Grouping Jobs – Departmentation – The Delegation Process – Decentralization and Centralization – Differences between Line and Staff. (4)

**MANAGING ORGANIZATIONAL CHANGE AND INNOVATION:** Steps in the Change Process – Understanding Resistance to Change – Overcoming Resistance to Change – Changing Business Processes – Organization Development – The Innovation Process – Forms of Innovation – The Failure to Innovate – Promoting Innovation in Organizations. (5)

**MANAGING HUMAN RESOURCES INORGANIZATIONS:** The Strategic Importance of HRM – The Legal Environment of HRM – Human Resource Planning – Recruiting Human Resources – Selecting Human Resources – Training and Development – Performance Appraisal – Performance Feedback. (4)

**MANAGING WORK GROUPS AND TEAMS:** Types of Groups and Teams – The reality of Virtual Teams – Stages of Group and Team Development Behavioural Norms – Cohesiveness – Formal and Informal Leadership – The Nature of Conflict – Causes of Conflict – Stimulating Conflict – Controlling Conflict – Resolving and Eliminating Conflict. (4)

**Total 42**

**TEXT BOOK:**

1. Ricky W Griffin, "Management", Houghton Mifflin, 2002.



**REFERENCES:**

1. Radha R Sharma, "Change Management – Concepts and Applications", Tata McGraw Hill, New Delhi, 2007.
2. Philip Kotler, "Marketing Management", Pearson Education Asia, New Delhi, 2003.
3. Khanna O P, "Industrial Engineering & Management", Dhanpat Rai Publications, New Delhi, 2003.

**08O049 ORGANISATIONAL BEHAVIOUR****3 0 0 3**

<b>MEANING &amp; IMPORTANCE OF OB:</b> Historical Development & Contributing Disciplines.	(2)
<b>PERSONALITY AND EMOTIONS:</b> Its Determinants & Attributes – Values & Attitudes – Components and Functions of Attitudes – Emotional Intelligence.	(3)
<b>MOTIVATION:</b> Basic Concepts, Motivation Theories, Problems in Motivation.	(2)
<b>VALUES:</b> Attitudes and Job Satisfaction.	(2)
<b>GROUP DYNAMICS:</b> Types of Groups, Group Norms and Cohesiveness: Group Roles.	(2)
<b>COMMUNICATION:</b> Functions – Fundamentals and Current Issues.	(3)
<b>TEAM BASED ORGANIZATION:</b> Need for Teams – Team Building – Effectiveness of Teams.	(3)
<b>ORGANIZATIONAL CULTURE:</b> Element, Culture and Performance Merging Organizational, Cultures, Changing and Strengthening Culture.	(3)
<b>CONFLICTS AND NEGOTIATION.</b>	(3)
<b>LEADERSHIP:</b> Theories of Leadership, Leadership Styles and Effectiveness.	(4)
<b>EMPLOYMENT RELATIONSHIP AND CAREER DYNAMICS:</b> The Psychological Contract – Socialization – Organizational Careers – Contingent Workforce.	(4)
<b>ORGANIZATIONAL CHANGE:</b> Forces for Change Force - Resistance to change Field - Analysis Model – Organization Development.	(4)
<b>WORK STRESS:</b> Causes and Consequences – Stress coping Strategies.	(4)
<b>CASES</b>	(3)

**Total 42****TEXT BOOK:**

1. Luthan Fred, "Organizational Behaviour", Mc Graw Hill Inc., New York, 2000.

**REFERENCES:**

1. Mcshane Vonglinow, "Organisational Behaviour", Tata Mc Graw Hill, 2001.
2. Robbins Stephen P, "Organizational Behaviour", Prentice Hall (India) Pvt. Ltd., New Delhi, Ninth Edition, 2000.
3. Kreitner Robert, Kinicki, Angelo, "Organisational Behaviour", Irwin Inc., Illinois, 1997.
4. New Newstorm John W and Davis Keiuth, "Organizational Behaviour – Human Behaviour at Work", Tata Mc Graw Hill Publishing Co., Ltd., New Delhi, 1995.

**08O050 VALUE MANAGEMENT****3 0 0 3**

<b>INTRODUCTION:</b> Management Science –Art – Development of Management as a profession – Principles of Scientific Management.	(4)
<b>VALUE BASED MANAGEMENT :</b> Creating Shareholder Value.	(3)
<b>MINTZBERG'S MANAGEMENT ROLES.</b>	(1)
<b>PLANNING:</b> The meaning and purpose of planning – Steps in Planning –Types of Plans.	(4)
<b>MANAGEMENT BY OBJECTIVES.</b>	(2)
<b>POLICIES, PROCEDURES AND METHODS:</b> Nature and type of policies – functional policies.	(2)
<b>DECISION MAKING PROCESS AND FUNDAMENTALS:</b> Types of decisions.	(2)
<b>ORGANIZING:</b> Meaning and structure – Authority and span of control, Delegation and decentralization – Line and Staff relationship.	(4)

<b>STAFFING:</b> Sources of recruitment – Selection Process.	(3)
<b>CO-ORDINATION:</b> Steps to promote coordination.	(1)
<b>DIRECTING:</b> Nature of directing – Leadership, motivation and communication.	(3)
<b>CONTROLLING IN MANAGEMENT:</b> Control Process.	(5)
<b>CHANGE MANAGEMENT:</b> Organizational Change, Perspectives on Organizational Change.	(4)
<b>INNOVATION MANAGEMENT.</b>	(4)

**Total 42**

**TEXT BOOK:**

1. Koontz Harold and Wehrich Heinz, "Essentials of Management: An International Perspective", Tata McGraw Hill, 2004.

**REFERENCES:**

1. Tripathi P C and Reddy R N, "Principles of Management", Tata McGraw Hill, 2006.
2. Satyaraju Parthasarathy, "Management", Prentice Hall India Pvt. Ltd., 2006.
3. Rao V S P and Hari Krishna V, "Management: Text and Cases", Excel Books, 2002.

### 08O051 HUMAN VALUES AND PROFESSIONAL ETHICS

**3 0 0 3**

<b>MANAGEMENT:</b> Meaning, Definition, Significance, Functions – Planning, Organizing, Staffing, Directing and Controlling, Principles of Management.	(4)
<b>SOCIAL RESPONSIBILITY AND ETHICS:</b> Concept of Social Responsibility, Views of Social Responsibility – Economic Objectives Vs Social Objectives – Business Ethics.	(4)
<b>PROBLEM SOLVING METHODS:</b> SWOT Analysis of a Traditional Engineer – Kaizen Strategy and Values – Kaizen Approach for Problem Solving.– Process Oriented Management Vs Result Oriented Management.	(4)
<b>HUMAN VALUES:</b> Value Crisis in Contemporary Indian Society, Aesthetic Values, Moral and Ethical Values, Spiritual Values, Values in the Work Place.	(4)
<b>INTERPERSONAL RELATIONSHIPS:</b> Managing Emotions, Emotional Intelligence, Building Better Interpersonal Relations, Managing the Boss, Dealing with Subordinates – Case Study.	(5)
<b>CREATIVITY:</b> Creativity and Problem Solving – Creativity Process – Creative Individuals and their Characteristics – Techniques for Creative Problem Solving.	(4)
<b>HUMAN RESOURCE MANAGEMENT:</b> Importance, Objectives, Functions, Job Analysis and Recruitment, Selection and Placement.	(4)
<b>HUMAN RESOURCE DEVELOPMENT:</b> Training and Learning, Determining Training Needs and Priorities, Formal Employee Training Methods, Management Development , Methods for Developing Managers, Evaluating Training Effectiveness – Case Study.	(5)
<b>LEADERSHIP:</b> Definition, Characteristics of Leadership, Leadership styles, Theories of Leadership – Tannenbaum – Schmidt Leadership Continuum – Managerial Grid Theory.	(4)
<b>MOTIVATION:</b> Meaning and Definition – Mechanism of Motivation – Maslow's Need Hierarchy Theory, Mc Gregor's Theory X and Y- Herzberg's Two Factor Theory.	(4)

**Total 42**

**TEXT BOOKS:**

1. Tripathi A N, "Human values" , New Age international Pvt. Ltd., New Delhi, 2002
2. Mamoria C B, "Personnel Management", Sultan Chand & Sons, New Delhi, 2002.

**REFERENCES:**

1. Jayshree Suresh and Raghavan B S, "Professional Ethics" S. Chand & Company Ltd., New Delhi, 2005.
2. Harold Koontz, Heinz Wehrich and Ramachandra Aryasri, "Principles of Management", Tata McGraw Hill, New Delhi, 2004.
3. Bishop, Sue, "Assertiveness Skills Training – A Source Book of Activities" , Viva Books Pvt. Ltd., New Delhi, 2002.

## 080052 MICRO ECONOMIC ENVIRONMENT

3 0 0 3

<b>INTRODUCTION TO MICRO ECONOMICS:</b> Basic problems of an Economy – Business Decisions.	(5)
<b>MARKET MECHANISM:</b> Price determination by demand and supply forces – Taxes and Subsidies.	(6)
<b>ELASTICITIES OF DEMAND AND SUPPLY:</b> Applications.	(4)
<b>THEORY OF CONSUMER BEHAVIOUR:</b> Consumer Surplus – Applications.	(4)
<b>THEORY OF PRODUCTION AND COSTS:</b> Short run and long run – Economies of Scale.	(4)
<b>MARKET STRUCTURE:</b> Perfect competition, monopoly, oligopoly and monopolistic competition.	(6)
<b>INTRODUCTION TO GAME THEORY.</b>	(5)
<b>EXTERNALITIES AND PUBLIC GROWTH.</b>	(4)
<b>UNCERTAINTY AND RISK.</b>	(4)

**Total 42**

### TEXT BOOK:

1. Alee Chrystal K and Richard G Lipsey, "Economics for Business and Management", Oxford University Press, 1997.

### REFERENCES:

1. Francis Cheraneelam, "Business Environment – Text & Cases", Himalaya Publishing House, Mumbai, 2006.
2. Pindyck R S and Rubin Feld D L., "Micro Economics", Prentice Hall of India, 2002.

## 080053 MARKETING SYSTEMS

3 0 0 3

<b>DEFINITION:</b> Scope – Philosophies of Marketing Management – Goals of Marketing Systems – Marketing Strategy – An overview of the Process.	(3)
<b>OPPORTUNITY ANALYSIS:</b> Identifying Attractive Markets – Macro Trend Analysis – The Demographic Environment – Socio Cultural Environment – Economic Environment – Political / Legal Environment – Technological Environment Case Analysis.	(3)
<b>INDUSTRY ANALYSIS AND COMPETITIVE ADVANTAGE:</b> Defining Markets and Industry – Industry Analysis Porter's Five Competitive Forces.	(3)
<b>CONSUMER MARKETS AND BUYING BEHAVIOUR:</b> Buying Population – Buying Decision – Buying Participants – Buying Influences – Buying Process – Case Analysis.	(4)
<b>MARKET SEGMENTATION, TARGETING, AND POSITIONING:</b> Marketing Mix – Different Targeting Strategies – The Positioning Process – Case Analysis.	(4)
<b>THE MARKETING INFORMATION SYSTEMS:</b> The Concept of Market – Information System.	(3)
<b>PRODUCT PLANNING AND POLICY:</b> New Product Development – Product Life Cycle – BCG Matrix – Product Branding, Brand Positioning, Packaging and Service.	(3)
<b>PRODUCTMIX STRATEGIES:</b> Branding Strategies – Sustaining Competitive Advantage over the Product Life Cycle.	(3)
<b>PRICING:</b> Setting of Price – Initiating Price Changes – Responding to Price Changes – Discount Structure – Factors Influencing Price Determination – Price Strategies.	(3)
<b>MARKETING CHANNEL AND PHYSICAL DISTRIBUTION:</b> Channel Design – Channel Management – Channel Modification – Retailing – Wholesaling.	(3)
<b>INTRODUCTION TO ADVERTISING, SALES PROMOTION AND PUBLIC RELATIONS:</b> Publicity and Personal Selling.	(3)
<b>DEVELOPING AND MANAGING AN ADVERTISING PROGRAM:</b> Effectiveness of Advertising.	(3)
<b>INDUSTRIAL MARKETING:</b> Characteristics of Industrial Markets – Consumer Markets and Industrial Markets – Buying Behaviour Models.	(4)

**Total 42**

### TEXT BOOK:

1. Philip Kotler and Kevin Keller, "Marketing Management", Prentice Hall of India, Twelfth Edition, 2005.

**REFERENCES:**

1. Michael J Etzel, Bruce Walker, William J Stanton and Ajay Pandit, "Marketing – Concepts and Cases", Tata McGraw Hill, 2006.
2. Walker, Boyd, Mullins and Lanrcher, "Marketing Strategy – A Decision Focused Approach", Tata McGraw Hill, 2003.

**08O054 ENTREPRENURSHIP****3 0 0 3**

**INTRODUCTION TO ENTREPRENEURSHIP:** Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance of Entrepreneurship. (5)

**CREATIVITY AND INNOVATION:** The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. (5)

**DEVELOPING AN EFFECTIVE BUSINESS MODEL:** The Importance of a Business Model – Components of an Effective Business Model – Developing and Writing the Business Plan. (6)

**APPRAISAL OF PROJECTS:** Importance of Evaluating various options – Appraisal Techniques. (4)

**FORMS OF BUSINESS ORGANIZATION:** Sole Proprietorship – Partnership – Joint Stock Companies and Cooperatives. (4)

**FINANCING THE NEW VENTURE:** Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Evaluating Financial Performance. (4)

**THE MARKETING FUNCTION:** Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. (6)

**MANAGING GROWTH OF NEW VENTURES:** Challenges of Growth – Strategies for Firm Growth – Internal and External Growth Strategies. (4)

**ETHICAL AND SOCIAL RESPONSIBILITY CHALLENGES FOR ENTREPRENEURS:** Ethics, Values and Social Responsibility – Ethics and Business Decisions. (4)

**Total 42****TEXT BOOK:**

1. Robert D Hisrich, Michael P Peters and Dean Shepherd, "Entrepreneurship", Tata McGraw Hill, 2007.

**REFERENCES:**

1. Bruce R Barringer and Duane Ireland, "Entrepreneurship – Successfully Launching New Ventures", Pearson – Prentice Hall, 2006.
2. Mary Coulter, "Entrepreneurship in Action", Prentice Hall of India, 2006.
3. Marc J Dollinger, "Entrepreneurship – Strategies and Resources", Pearson Education, 2003.

**08O055 ANALYSIS OF MANUFACTURING AND SERVICE SYSTEMS****3 0 0 3**

**CONCEPT OF OPERATIONS MANAGEMENT:** Characteristics of Manufacturing Sector and Service Sector – Evolution of Operations Management Discipline – Concepts and Calculations of Productivity – Productivity Improvement Measures. (5)

**CONCEPT OF TOTAL QUALITY MANAGEMENT:** KAIZEN - Philosophies of Deming, Juran and Crosby – Statistical Process Control – Concept of Acceptance Sampling. (4)

**DEMAND FORECASTING:** Moving Average – Exponential Smoothing – Trend Projections – Regression and Correlation Analysis. (4)

**JOB PRODUCTION:** Mass Production – Batch Production – Continuous Processing – Special Projects – Make or Buy Decisions. (4)

**LOCATION ANALYSIS:** Centres of Gravity Method – Factor Rating Method – Locational Breakeven Analysis Method. (4)

**LAYOUT ANALYSIS:** Process Layout and Cellular Layout – Line Balancing. (6)

**MATERIALS MANAGEMENT:** Aggregate Production Planning – Gantt Charts – Sequencing and Scheduling. (5)

**METHOD STUDY:** Concept – Techniques of Work Study – Method Study – Definition – Procedure for Method Study – Principles of Motion Economy – Selection – Recording – Techniques – Uses of Films – Examine – Develop – Install and Maintain.

**WORK MEASUREMENT:** Definition – Objectives – Techniques of Work Measurement – Time Study – Procedure – Advantages. (4)

**PRODUCTION MANAGEMENT:** Types of Production – Characteristics – Application – Standardization – Objectives – PPC – Objectives – Functions – Preplanning – Routing – Scheduling – Dispatching and Controlling. (6)

**Total 42**

**TEXT BOOK:**

1. Buffa E S and Sarin R K, "Modern Production / Operations Management", John Wiley & Sons, Singapore, 2000.

**REFERENCES:**

1. Lee J Krajewski and Larry P Ritzman, "Operations Management-Strategy and Analysis", Pearson Education, 2005.
2. Chase R B, Aquilano N J and Roberts F R, "Production and Operations Management: (Manufacturing and Services)", Tata McGraw Hill, New Delhi, 1999.
3. Heizer J and Render B, "Production and Operations Management: (Strategies and Tactics)", Prentice Hall New Jersey, 1996.

## 080056 FINANCIAL AND MANAGEMENT ACCOUNTING

**3 0 0 3**

**MANAGEMENT ACCOUNTING:** Meaning – Nature and Scope – Functions – Limitations – Need – Financial Accounting vs. Management Accounting. (3)

**FINANCIAL STATEMENTS:** Characteristics – Limitations – Financial Statement Analysis – Ratio Analysis. (5)

**FUND FLOW STATEMENT:** Meaning and Concept of Flow of Funds – Meaning of a Fund Flow Statement – Differences between Fund Flow Statement and Income Statement – Preparation and Interpretation of Fund Flow Statement. (4)

**CASH FLOW STATEMENT:** Meaning of a Cash Flow Statement – Classification of Cash Flows – Preparation and Interpretation of Cash Flow Statement. (4)

**FINANCIAL MANAGEMENT:** An Overview – Nature and Scope – Finance Functions – Goals of Financial Management – Financial Manager's Role – Agency Problems, Agency Cost – Economic Value Added. (5)

**SOURCES OF FINANCE:** Long Term Finance – Ordinary Shares – Right Issue of Equity Shares – Preference Shares – Debentures – Term Loan – Asset Based Financing – Hire Purchase – Leasing – Venture Capital Financing – Short Term Finance – Trade Credit - Bank Credit – Bill Discounting – Commercial Paper. (5)

**TIME VALUE OF MONEY:** Concept – Future Value – Present Value – Single Cash Flows – Annuity – Uneven Cash Flows – Multi Period and Continuous – Yield Calculation. (4)

**INVESTMENT DECISION:** Capital Budgeting Decisions – Evaluation of Capital Budgeting – Discounted and Non Discounted – Cash Flows Methods – Simple Problems. (4)

**FINANCING AND DIVIDEND DECISION:** Capital Structure – Financial Leverage – Operating Leverage – Only Concepts – Capital Structure Theories – Dividend Theories. (4)

**WORKING CAPITAL:** Policies for Financing Current Assets. (2)

**RECEIVABLES MANAGEMENT, INVENTORY MANAGEMENT AND CASH MANAGEMENT:** Basic Concepts Only. (2)

**Total 42**

**TEXT BOOK:**

1. Damodar Aswath, "Corporate Finance-theory and Practice", Tata McGraw-Hill, New Delhi, 2005.

**REFERENCES:**

1. Ross S A, Westerfield R W and Jordan B D, "Fundamentals of Corporate Finance", Tata McGraw-Hill, New Delhi, 2006.
2. Myers Brealey, "Principles of Corporate Finance", Vikas Publishing House P Ltd, 2005.
3. Pandey I M, "Financial Management", Ninth Edition, Vikas Publishing House P Ltd, 2005.
4. Prasanna Chandra, "Financial Management", Tata McGraw-Hill, New Delhi, 2004.

## 080057 MANAGERIAL FINANCE

3 0 0 3

**THE FINANCE FUNCTION:** The Nature of the Firm and Its Goals – Value Maximization as a Goal – Role of Financial Management. (5)

**FINANCIAL STATEMENTS:** Sample Income Statement – Sample Balance Sheet – Sources and Uses of Funds – Reporting Requirements. (4)

**THE TAX ENVIRONMENT:** Corporate Income Tax – Personal Income Tax. (4)

**DEPRECIATION METHODS:** Straight Line – Sum-of-Years'-Digits – Units of Production – Declining Balance Methods – Effect of Depreciation on Taxes Paid – Depreciable Life of an Asset. (4)

**THE TIME VALUE OF MONEY:** Future Value – Present Value – Present Value of an Annuity. (4)

**CAPITAL BUDGETING TECHNIQUES:** Significance of Capital Budgeting – Ranking Investment Proposals – Projects with Different Lives – Projects with Different Scale. (4)

**FINANCIAL RATIO ANALYSIS:** Basic Financial Statements – Basic Types of Financial Ratios – Use of Financial Ratios – Some Limitations of Ratio Analysis. (5)

**PORTFOLIO THEORY – DECISION MAKING UNDER UNCERTAINTY:** Introduction – Market Equilibrium – Pricing Inefficient Portfolios. (4)

**SENSITIVITY ANALYSIS OF RISKY PROJECTS:** Monte Carlo Simulation Analysis – Decision Trees. (4)

**CAPITAL STRUCTURE AND THE COST OF CAPITAL:** Leverage and the Cost of Capital – Theory – Calculating the Component Financing Costs. (4)

**Total 42**

### TEXT BOOK:

1. Fred Weston J and Thomas E. Copeland, "Managerial Finance", The Dryden Press, London, 1982.

### REFERENCES:

1. Samuels J M, Wilkas F M and Bray Shaw R E, "Financial Management & Decision Making", International Thomson Business Press, 1999.
2. John J Pringle and Robert S Harris, "Essentials of Managerial Finance", SCOH Foresman and Company, London, 1987.
3. Fred Weston J and Eugene F Brigham, "Essentials of Managerial Finance", Holt-Saunders International Editions, New York, 1982.

## 080058 WORKING CAPITAL MANAGEMENT

3 0 0 3

**WORKING CAPITAL POLICY:** Importance of Working Capital Management – Risk-Return Tradeoff for Current Asset Investments – Financing Current Assets – The Costs and Risks of Alternative Debt Maturities. (6)

**CASH AND MARKETABLE SECURITIES MANAGEMENT:** Cash and Marketable Securities Management – Managing Disbursements – Marketable Securities – Cash Management Models. (6)

**CASH MANAGEMENT MODELS:** Baumol Model – Miller-Orr Model – Beranek Model – A Comparison of the Models. (6)

**INVENTORY MANAGEMENT:** Inventory – Generality of Inventory Analysis – The EOQ Model – Extending the EOQ Model. (6)

**CREDIT MANAGEMENT AND POLICY:** Credit Standards – Terms of Trade Credit – Evaluating Changes in Credit Policy – Use of Computers in Credit Management. (6)

**THE PAYMENTS PATTERN APPROACH:** Corporate Practice – Payments Pattern Approach. (6)

**SHORT-TERM FINANCING:** Trade Credit – Short-Term Financing by Commercial Banks – Commercial Paper – Bankers' Acceptances – Secured Short-Term Financing – Accounts Receivable Financing – Inventory Financing. (6)

**Total 42**

### TEXT BOOK:

1. Fred Weston J and Thomas E Copeland, "Managerial Finance", The Dryden Press, London, 1982.

### REFERENCES:

1. Krish Rangarajan and Anil Misra, "Working Capital Management", Excel Book, New Delhi, 2005.
2. Bhalla V K, "Working Capital Management", Anmol Publications Pvt Ltd, New Delhi, 2003.
3. Srinivasan S, "Cash and Working Capital Management", Vikas Publishing House Pvt Ltd., 1999.

## 080059 COST MANAGEMENT

3 0 0 3

<b>COST MANAGEMENT - An overview:</b> Definition of Cost Management – Traditional Cost Accounting and Cost Management.	(5)
<b>COST CONCEPTS IN DECISION MAKING.</b>	(4)
<b>VARIABLE (MARGINAL) COSTING:</b> Concepts of Absorption and Variable Costing.	(4)
<b>COST-VOLUME-PROFIT (CVP) RELATIONSHIP:</b> Techniques of CVP Analysis.	(4)
<b>DECISION-MAKING PROBLEMS:</b> Decision-making – types of decision-making problems.	(4)
<b>PRODUCT PRICING DECISIONS:</b> Factors Influencing Pricing Decisions – Different Methods of Pricing.	(4)
<b>BUDGETING:</b> Concept of Budgeting – Concept of Budgetary Control – Objectives and Functions of Budgeting.	(5)
<b>ACTIVITY-BASED MANAGEMENT:</b> Traditional Product Costing – Meaning of Activity-based Costing – Comparing ABC with Conventional Costing System.	(4)
<b>INVENTORY MANAGEMENT:</b> Meaning – Inventory Systems.	(4)
<b>QUAMTITATIVE TECHNIQUES FOR DECISION MAKING AND COST MANAGEMENT:</b> LP – PERT – CPM.	(4)

**Total 42**

### TEXT BOOK:

1. Jawahar Lal, "Cost Management", Tata McGraw Hill, New Delhi, 2004.

### REFERENCES:

1. Edward J Blocher, Kung H Chen, Gary Cokins and Thomas W Lin, "Cost Management", Tata McGraw Hill, New Delhi, 2006.
2. Bhattacharyya S K and John Dearden, "Costing for Management", Vikas Publishing House Pvt Ltd., New Delhi, 2002.
3. Ronald W Hilton, Michael W Maher and Frank H Selto, "Cost Management", Tata McGraw Hill, 2002.

## 080060 TECHNOLOGY INCUBATORS AND COMMERCIALISATION OF INNOVATION

3 0 0 3

<b>EVOLUTION OF MANUFACTURING:</b> System of Manufacture - Scientific Management – Process Improvement – Numerical Control – Computer Integrated Manufacturing.	(6)
<b>INNOVATION:</b> Innovation Process – Why R & D – Patents – Capitalizing on R & D – Economic Justification and Innovation.	(6)
<b>OVERVIEW AND PREPARATION:</b> Marketing Innovations – Product Improvements – Technological Innovation – Routes of New Products Development and Its Significance.	(6)
<b>COMMERCIALISATION:</b> Control and Launch Cycle – Marketing Plan – Strategy and Promotion – Product – Price and Distribution – Post-Launch Tracking and Control.	(6)
<b>TECHNOLOGY BUSINESS INCUBATOR:</b> Benefits of TBI – Agencies Involved – Global Scenario of TBI – Indicators of Success for TBI.	(6)
<b>DIFFERENT MODELS OF TBI:</b> Features – Incubation Process – Tenant – Idea – Technology Based.	(6)
<b>GLOBALIZING CHANGE:</b> Joint Production versus – Co-Production – Global New Product Launch.	(6)

**Total 42**

### TEXT BOOK:

1. Shlomo Maital and Seshadri D V R, "Innovation Management", Response Books, New Delhi, 2007.

### REFERENCES:

1. John E Ettlle and Buherworth-Heinemann, "Managing Innovation", Elsevier, New Delhi, 2006.
2. Sudan A S and Naveen Kumar, "Organization Effectiveness and Change", Anmol Publications Pvt Ltd, New Delhi, 2004.
3. Shajahan S, "New Product Strategy and Management", Himalaya Publishing House, Mumbai, 2001.

## LANGUAGE

### 08O061 PROFESSIONAL ENGLISH

3 0 0 3

**LEARNING ENGLISH THROUGH LITERATURE:** Literary texts drawn from English and American Literature, and Indian writing in English to be used

Short Stories	(6)
One Act play	(4)
Poetry	(6)
Literary Essay	(6)

#### **PROFESSIONAL AND SOFT SKILLS TRAINING IN ENGLISH:**

Intra & Interpersonal Communication	(2)
Interview Techniques	(2)
Group Communication	(5)
Etiquette – Body Language, Telephone Conversation etc.	(2)
Professional report writing	(3)
Mass Communication – email writing / public speaking/ presentation techniques/ preparing Advertisements	(6)

**Total 42**

#### **TEXT BOOK:**

1. Teaching Material prepared by the Faculty, Department of English

#### **REFERENCES:**

1. Bert Decker, "The Art of Communicating", Decker Communications, Inc., USA, 2004.
2. Meenakshi Raman and Sangeeta Sharma, "Technical Communication: Principles and Practice". Oxford University Press, U K, 2004.
3. Dale A Level Jr and William P Galle Jr, "Managerial Communications", Business Publications, INC., Plano, Texas, 1988
4. Albert Joseph, "Writing Process 2000", Prentice Hall, New Jersey, 1996

### 08O062 INITIATIVE TO GERMAN LANGUAGE

3 0 0 3

**INTRODUCTION:** Alphabets, Greetings, Vocabulary, Grammar – Pronouns, Verbs and their conjugations, Articles, Question words, Statements and questions, Negation, Countries, Nationalities and Languages. Simple dialogues, Exercises. (10)

**POSSESSIVE PRONOUNS:** Family, Professions , the verb 'sein', Number system, Nouns – singular and plural. Imperative statements. A small text and dialogues related to family. Exercises. (7)

More irregular verbs, Accusative and dative declensions of pronouns and articles. Modal verbs and their related grammatical structure. Dialogues and usages of modal verbs. Exercises. (8)

Time and time related particles. Daily routines, related verbs and question words. Related vocabulary and grammar. Sample dialogues and exercises. (8)

Separable and inseparable verbs and their related usage pattern. Invitations and telephone conversations. Exercises.

(FINAL EXAM – Hearing , Oral and Written) (3)

**Total 42**

#### **TEXT BOOK :**

1. To be modeled by the Faculty.

#### **REFERENCES :**

1. Tangram Aktuell 1 (Deutsch als Fremdsprache) - Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr - Max Hueber Verlag, 2004.
2. Lernziel Deutsch - Wolfgang Hieber - Max Hueber Verlag, 1983.
3. Grundkurs Deutsch - Roland Schäpers, Renate Luscher , Manfred Glück, 1980.



## 08O063 BASIC FRENCH

3 0 0 3

### INTRODUCTION

(2)

**DOSSIER 0:** Rencontres, presentations, nationalities - saluer, vous excuser, vous presenter - demander et donner votre identité - computer et peeler des mots - les verbes etre, avoir et s' appeler, au present (singulier) -des noms et des adjectives au singulier - C'est + nom ou pronom - // est + adjective - La negation ne... pas - Des phrases interrogatives. (10)

**DOSSIER 1:** l' arrivee en France - une inscription (a un club de cyclotourisnce) - ce qu' on dit en classe ( consignes) - Vous informer sur l' identite d'une personne - distinguer les formes – familiares et les formes de politesse - des articles et des adjectives possessifs, au singulier - des mots interrogatifs: quell (adjective), qui (pronoun) ou, comment (adverbs) - des noms de professions. (10)

**DOSSIER 2:** la famille - quelques personagers celebres - presener votre famille et des amis - dire ou sont les gens et d'ou ils viennent - les verbes en-er, etre, avoir, faire et venire au present - le plural des noms, des adjectives, des articles et des adjectives possessifs - la negation ne ... pas de + nom - l' interrogation avel est – ce que - a, an et de + nouns de villes et de pays. (10)

**DOSSIER 3:** maisons et appartements - demenagements, locations, petites annonces – monuments parisiens - situer des meubles et des objects ( la localisation) - indiquer la possession - donner des orders et des interdctions - exprimer l' accord et le refus-les verbes en-er, faire, prendre et nettre, au present et a l' imperative - le pronom on - les pronoms toniques après preposition - les adjectives demonstratifs - les adjectives ordinaux - la response si - il ya ... un / des. (10)

Total 42

### REFERENCE:

1. Capelle, Guy and Gidon, Noelle. Le Nouvel Escapes. Paris: Hachette Livre, 1998.

## 08O064 BASIC CONVERSATIONAL SKILLS IN JAPANESE LANGUAGE

3 0 0 3

**ORIENTATION:** Geographic and socio-economic perspective of Japan, people and culture, basic greetings. Basic scripts – Hiragana and Katakana , sounds and combinations. Basic particles and introductions to demonstratives, place markers and direction markers. (10)

**TIME RELATED WORDS:** Time of day, days of the week, months and dates of a month. Asking for and telling the time. Verb tenses – Present/future and past. Destination markers, direct object particle and other particles related to mode of transportation and place of action. (10)

**ADJECTIVES:** Introduction to adjectives, types and negative forms, different usages, comparisons, likes and dislikes. Verbs denoting presence and related particles. Counters and counting suffixes. Sentences involving need and desire, wanting to perform an action and movement for a certain purpose. (10)

**VERBS:** Groups (I, II and III) and exercises in group verbs. Describing a natural phenomenon, habitual action and a continuing state. Sentences involving asking for and granting permission. (6)

**ROLE PLAYS IN JAPANESE:** Demonstration on usage of chopsticks – Japanese tea party. (6)

Total 42

### REFERENCE:

1. Minna no Nihongo I Honsatsu Roma-ji ban (Main Textbook Romanized version)

## DEPARTMENT ELECTIVES

### 08E001 COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES

3 0 0 3

**COMPUTER AIDED DESIGN (CAD):** Need for CAD - Nature of design problem - Analysis and synthesis approaches - Preparation of design procedures - Branching - Decision and structure tables - Iterative procedures - Flow charting. (6)

**COST ESTIMATION:** Aim and importance - Material cost -Labour cost -Overhead cost -Running cost - Life cycle cost. (5)

**OPTIMUM DESIGN:** Selection of objective function, variables and constraints - Effects of variables on objective function and performance - Non-linear programming approach. (6)

**COMPUTER AIDED DRAWING:** Introduction - Graphic input & output devices – AutoCAD-Program files - Installation - Screen menu structure - Fixing the size of a drawing - Set-up option - On-line help - Text fonts, shapes - Blocks - Copy - Array - Erasing facilities - Editing - Fill - Zoom - Pan - Hatching - Isoplane - Elevation, View point - Dimensioning techniques - Introduction to 3D drawing - Taking hard copy using printer and plotter. (8)

**INDUCTION MACHINE DRAWINGS:** Cross sectional views - Development of winding diagram. (5)

**FINITE ELEMENT ANALYSIS:** Mathematical formulation – discretisation – shape functions – stiffness matrix – solution techniques – post processing - Numerical solution for partial differential equations. (6)

**TYPICAL DESIGN EXAMPLE:** Three phase Induction motor – Design analysis - Performance predictions - Flow chart for feasible design. (6)

**Total 42**

**TEXT BOOKS:**

1. Sen S K, "Principles of Electric Machine Design with Computer Programmes", Oxford & IBH Publishing Co. Pvt. Ltd., 2001, Reprint 2004.
2. Silvester P P and Ferrari, 'Finite Element for Electrical Engineers', Cambridge University Press, 1984.

**REFERENCES:**

1. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", Affiliated East-West Press Pvt Ltd, New Delhi, 1987.
2. Robert M Thomas, "Advanced Techniques in AutoCAD", BPB Publications, New Delhi, 1988.
3. Veinott C G, "Computer Aided Design for Electric Machinery", MIT Press, London, 1972.
4. Sham Tickoo, "Auto CAD 2002 with Applications" Tata McGraw Hill publishing company limited, New Delhi, 2001.
5. George, Omura, "Mastering AutoCAD", BPB Publications, New Delhi, 1988.

## **08E002 PLC AND DISTRIBUTED CONTROL SYSTEM**

**3 0 0 3**

**INTRODUCTION TO FACTORY & PROCESS AUTOMATION:** PLC introduction – Need for Automation – Vertical Integration of Industrial Automation- Control elements in industrial automation. (5)

**PROGRAMMABLE LOGIC CONTROLLERS:** Basics of PLC - Architecture of PLC - Advantages - Types of PLC - Introduction to PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet (9)

**PROGRAMMING OF PLC:** Types of Programming - Simple process control programs using Relay Ladder Logic and Boolean logic methods - PLC arithmetic functions - Introduction to advanced programming methods. (10)

**HMI SYSTEMS:** Necessity and Role in Industrial Automation, Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI) (5)

**DISTRIBUTED CONTROL SYSTEMS (DCS):** Difference between SCADA system and DCS – architecture – local control unit – programming language – communication facilities – operator interface – engineering interfaces. (8)

**APPLICATIONS OF PLC & DCS:** Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS (5)

**Total 42**

**TEXT BOOKS:**

1. John W Webb & Ronald A Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2003.
2. Michael P Lukas, "Distributed Control systems", "Van Nostrand Reinhold Company"1995

## **08E003 HIGH VOLTAGE ENGINEERING**

**3 0 0 3**

**IONIZATION AND DECAY PROCESS:** Introduction- Ionization process- Types of ionization - Electron collision - Photo ionization - Thermal ionization - Electron detachment and recombination - Mobility of gaseous ions and Decay by diffusion - Cathode process. (5)

**ELECTRIC BREAKDOWN IN GASES:** Properties of insulating gases - Townsend's criterion for break down - Mechanism of spark - Breakdown voltage characteristics in uniform and non uniform fields - Penning effect - Time lag for breakdown - Corona discharges - Paschen's law. (5)

**ELECTRIC BREAKDOWN IN SOLIDS:** Intrinsic breakdown - Electromechanical breakdown - Stream breakdown - Thermal breakdown - Erosion breakdown - Breakdown of composite insulation - Solid dielectrics used in practice. (5)

**ELECTRIC BREAKDOWN IN LIQUIDS:** Electronic breakdown - Cavitation breakdown - Suspended particle mechanism - Conduction and breakdown in pure and commercial liquids. (5)

**GENERATION OF HIGH VOLTAGE AND HIGH CURRENTS:** Generation of high DC voltages - Cockroft - Walton voltage multiplier circuit - Electrostatic generator - Vande graaf generator - Generation of high AC voltages, Transformers in cascade - Construction of Impulse generator - Generation of Impulse voltages and currents - Tripping and control of Impulse generators. (6)

**MEASUREMENT OF HIGH VOLTAGES AND CURRENTS:** Measurement of high dc voltages - Measurement of high AC voltages - Electrostatic voltmeters - Impulse voltage measurements using voltage dividers - Measurement of High DC, AC and Impulse currents - Surge test oscilloscope. (5)

**NON DESTRUCTIVE TESTING OF MATERIALS AND ELECTRICAL APPARATUS:** Measurement of resistivity - High voltage dielectric loss measurement - Schering bridge - Measurement of large capacitance - Inductively coupled ratio - Arm bridge - Loss measurement on complete equipment - Discharge measurement - Recurrent surge generator. (6)

**HIGH VOLTAGE TESTING:** Testing of overhead line insulators- Testing of isolators and circuit breakers - Testing of surge diverters - Testing of cables - Testing of bushings - Testing of power capacitors and transformers - Radio interference measurements. (5)

**Total 42**

**TEXT BOOKS:**

1. Naidu M S, and Kamaraj V, "High Voltage Engineering", Tata McGraw Hill, New Delhi , Third Reprint 2004.
2. Wadhwa C L, "High Voltage Engineering", New Age International (P) Ltd., New Delhi, Reprint, 2002.

**REFERENCES:**

1. Ravindra Arora and Wolfgang Mosch, "High Voltage - Insulation Engineering", New Age International Publishers Limited, New Delhi, Reprint 2002.
2. Kuffel E, Zaengl W S, Kuffel J, "High Voltage Engineering: Fundamentals", Butterworth-Heinmann (A division of Reed Educational & Professional Publishing Ltd) Second Edition, 2000.
3. Rakosh Das Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Ltd., New Delhi, 1986.

## **08E004 HVDC TRANSMISSION**

**3 0 0 3**

**GENERAL ASPECTS:** Historical development--HVAC and HVDC links – Types - comparison – Economic technical performance – Reliability – Limitation. (5)

**CONVERTER CIRCUITS:** Properties of Thyristor converter circuits – Assumptions –Converters for HVDC – 12 pulse converter - parallel and series connection of converters - effect of source and load impedance- choice of best circuit for HVDC converters – Transformer connections – Reactive VAr requirement of converters. (6)

**ANALYSIS OF THE BRIDGE CONVERTER:** Analysis with gate control but no overlaps – With overlap less than 60 degrees - With overlap greater than 60 degrees - Complete characteristics of rectifier – operation of Inverter. (6)

**CONTROL:** Basic means of control – Gate control – Power reversal – constant current versus constant voltage – control characteristics – Stability of control – Frequency control – Multi terminal lines. (6)

**MISOPERATION OF CONVERTERS:** Converter disturbance – By pass action in bridges – Short circuit on a rectifier – Commutation failure. (5)

**PROTECTION:** Basics of protection – DC reactors – voltage and current oscillations – Clearing line faults and re-energising – Circuit breakers – over voltage protection – Control of di/dt and dv/dt. (6)

**HARMONICS:** Characteristic and un – characteristic harmonics – Troubles due to harmonics – Means of reducing harmonics – Harmonic filters – sources of reactive power – static var systems -Telephone interference. (5)

**CORONA:** Critical corona voltage and voltage stress – Corona discharge – Losses – Radio interferences (3)

**Total 42**

**TEXT BOOKS:**

1. Adamson C and Hingorani N G, "High Voltage Direct Current Power Transmission", Garaway Ltd., 1968.
2. Arrillaga J, "High voltage Direct Current Transmission", IEE Publications, London, UK, Second Edition,1999.
3. Padiyar K R, "HVDC Transmission Systems" ,New Age International Publishers Ltd., New Delhi ,Reprint 2002.

**REFERENCES:**

1. Kimbark E W, "Direct Current Transmission",vol 1 ,Wiley Interscience , New York,1971.
2. Uhmman E, "Power Transmission by Direct Current ",Springer International Edition,Firstm Indian Reprint,2004

## 08E005 SPECIAL MACHINES AND CONTROLLERS

3 0 0 3

**AC COMMUTATOR MOTORS:** Principle of operation – Equivalent circuit – Phasor diagram – Performance of Repulsion motor and Universal motor. (4)

**STEPPING MOTORS:** Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor. Different modes of Excitation - theory of torque predictions – linear and non-linear analysis – characteristics – drive circuits. (9)

**SWITCHED RELUCTANCE MOTORS:** Constructional features – principle of operation – torque prediction – power controllers – Nonlinear analysis – Microprocessor based control - characteristics – computer control. (10)

**PERMANENT MAGNET MOTORS :** Principle of operation – types – magnetic circuit analysis – EMF and Torque equations – Power Controllers – Motor characteristics and control of PMDC, PMSM , and BLDC motors. (10)

**LINEAR MOTORS :** Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types - Performance equations – Applications. (9)

Total 42

### REFERENCES:

1. Taylor E O, "The performance and design of AC Commutator motors", Sir Issac Pitman & Sons, London, 1998,
2. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 1984
3. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989
4. Naser A and Boldea L, "Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987.

## 08E006 ADVANCED CONTROL SYSTEMS

3 0 0 3

**CONTROLLER DESIGN:** Design and Performance analysis of P, PI, PID Controllers using MATLAB – Ziegler – Nichols tuning of PID Controller. (7)

**COMPENSATOR DESIGN:** Classical design, Examples - Realisation of compensating Networks - Lead, lag, laglead networks - Lead compensation, lag compensation, lag lead compensation - Network compensation – root locus approach. (7)

**STATE SPACE ANALYSIS:** State space representations – State Transition Matrix – Solution of State equations-Controllability and Observability – Pole placement by state feedback. (8)

**SAMPLED DATA SYSTEM:** Sampling process – Sample and hold - Reconstruction of sampled signals - Hold circuits zero and first order hold - Z and Inverse Z transform - Pulse transfer function - Step response. (8)

**NON-LINEAR SYSTEMS:** Introduction – Properties of Non-Linear systems – Describing function for simple non-linearities like on-off relay, dead zone, saturation and relay with hysteresis. Basic concepts – singular points – construction of phase plane trajectory for linear and non linear second order system – Isocline method – stability evaluation and limitcycle. (12)

Total 42

### TEXT BOOKS:

1. Ogata K, "Modern Control Engineering", Fourth Edition, Pearson/Prentice-Hall Of India Pvt Ltd., New Delhi, 2002
2. Gopal M, "Modern Control Systems Theory", New Age International publishers, 2007
3. Aggarwal K K, "Control Systems Analysis and design", Khanna Publishers, New Delhi, 2004.

### REFERENCES :

1. Benjamin C Kuo, "Automatic Control Systems", Eighth Edition, John wiley & sons, inc 2003.
2. Nagrath I J and Gopal M, "Control System Engg", Fifth Edition, New Age International publishers, 2007

## 08E007 VIRTUAL INSTRUMENTATION SYSTEMS

3 0 0 3

**INTRODUCTION:** General functional description of a digital instrument - Block diagram of a Virtual Instrument - Physical quantities and Analog interfaces - Hardware and Software - User interfaces - Advantages of Virtual instruments over conventional instruments - Architecture of a Virtual instrument and its relation to the operating system. (8)

**SOFTWARE OVERVIEW:** LabVIEW - Graphical user interfaces - Controls and Indicators - 'G' programming - Labels and Text - Shape, Size and Color - Owned and free labels - Data type, Format, Precision and representation - Data types - Data flow programming - Editing - Debugging and Running a Virtual instrument - Graphical programming palettes and tools - Front panel objects - Functions and Libraries. (8)

**PROGRAMMING STRUCTURE:** FOR loops, WHILE loops, CASE structure, formula nodes, Sequence structures - Arrays and Clusters - Array operations - Bundle - Bundle/Unbundle by name, graphs and charts - String and file I/O - High level and Low level file I/O's - Attribute modes Local and Global variables. (7)

**OPERATING SYSTEM AND HARDWARE OVERVIEW:** PC architecture, current trends, Operating system requirements, Drivers – Interface Buses – PCI Bus – Interface cards – specification – Analog and Digital interfaces – Power, Speed and timing considerations. (5)

**HARDWARE ASPECTS:** Installing hardware, Installing drivers - Configuring the hardware - Addressing the hardware in LabVIEW - Digital and Analog I/O function - Data Acquisition - Buffered I/O - Real time Data Acquisition. (7)

**LABVIEW APPLICATIONS:** IMAQ - Motion Control: General Applications - Feedback devices, Motor Drives - Instrument Connectivity - GPIB, Serial Communication - General, GPIB Hardware & Software specifications - PX1 / PC1: Controller and Chassis Configuration and Installation. (7)

**Total 42**

**TEXT BOOKS:**

1. Garry M Johnson, "Labview Graphical Programming", Tata McGraw Hill, New Delhi, 2<sup>nd</sup> Edition, 1996.
2. Labview : Basics I & II Manual, National Instruments, 2005.

**REFERENCES:**

1. Lisa K Wells, "Labview for Everyone", Prentice Hall of India, New Delhi, 1996.
2. Barry Paron, "Sensor, Transducers and Labview", Prentice Hall, New Delhi, 2000.
3. Sanjay Gupta and Joseph John, "Virtual Instrumentation Using LabVIEW", Tata McGraw-Hill Co. Ltd., 1<sup>st</sup> Edition, 2005.

## **08E008 NEURAL NETWORKS AND FUZZY SYSTEMS**

**3 0 0 3**

**INTRODUCTION TO NEURAL NETWORKS:** Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, McCulloch - Pitts Neuron, Simple Neural Nets for Pattern Classification, Linear Separability - Hebb Net, Perceptron, Adaline, Madaline - Architecture, algorithm, and Simple Applications. (7)

**PATTERN ASSOCIATION:** Training Algorithms for Pattern Association - Hebb rule and Delta rule, Heteroassociative, Autoassociative and Iterative Autoassociative Net, Bidirectional Associative Memory - Architecture, Algorithm, and Simple Applications. (6)

**NEURAL NETWORKS BASED ON COMPETITION:** Kohonen Self Organising Maps, Learning Vector Quantization, Counter Propagation - Architecture, Algorithm and Applications. (6)

**ADAPTIVE RESONANCE AND BACKPROPAGATION NEURAL NETWORKS:** ART1 and ART2 - Basic Operation and Algorithm, Standard Backpropagation Architecture, derivation of Learning Rules, Boltzmann Machine Learning - Architecture, Algorithm and Simple Applications. (6)

**CLASSICAL AND FUZZY SETS AND RELATIONS:** Properties and Operations on Classical and Fuzzy Sets, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems. (5)

**MEMBERSHIP FUNCTIONS:** Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods. (7)

**APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC:** Applications of Neural Networks: Pattern Recognition- Image compression-Communication- Control systems- Applications of Fuzzy Logic: Fuzzy Pattern Recognition- Fuzzy Image compression- Fuzzy Logic Controllers. (5)

**Total 42**

**TEXT BOOKS:**

1. Sivanandam S N, Sumathi S, Deepa S N, "Introduction to Neural Networks using Matlab 6.0," Tata McGrawHill Publications, New Delhi, 2005.
2. Laurene Fausett, "Fundamentals of Neural networks", Pearson Education India, New Delhi, 2004.
3. Timothy Ross, "Fuzzy Logic with Engineering Applications", Mc Graw Hill, Singapore, 1998.

**REFERENCES:**

1. Zimmermann H J, "Fuzzy set theory and its Applications", Allied Publishers Ltd, New Delhi, 1999.
2. Klir G J, and Folger T, "Fuzzy Sets, Uncertainty and Information", Prentice Hall, New Delhi, Englewood Cliffs.NJ, 5<sup>th</sup> Indian reprint, 2002.
3. Zurada J M, "Introduction to Artificial Neural systems", Jaico Publishing House, Bombay, 2006.
4. Mohammad H Hassoun, "Fundamentals of Neural Networks", Prentice hall of India, New Delhi, 2002.

## 08E009 VLSI DESIGN

3 0 0 3

**OVERVIEW OF VLSI DESIGN METHODOLOGY:** VLSI design process - Architectural design - Logical design - Physical design - Layout styles - Full custom - Semi custom approaches. (3)

**BASIC ELECTRICAL PROPERTIES OF MOS AND CMOS CIRCUITS:** MOS Transistor – Threshold voltage - Pass transistor - Transmission gate - Basic DC equations - Second order effects - MOS modules - Small signal AC characteristics - nMOS inverter - Steered input to an nMOS inverter - Depletion mode and enhancement mode pull ups - CMOS inverter - DC characteristics - Inverter delay – Power consumption in CMOS gates – Static dissipation – Dynamic Dissipation. (8)

**VLSI FABRICATION TECHNIQUES:** An overview of wafer fabrication - Wafer processing - Oxidation - Patterning - Diffusion - Ion implantation - Deposition - Silicon gate nMOS process – CMOS processes – n well - p well - Twintub - Silicon on insulator - CMOS process enhancements - Interconnect - Circuit elements - latchup - Latch up prevention techniques. (6)

**MOS AND CMOS CIRCUIT DESIGN PROCESSES:** Layer representations - Stick diagrams - nMOS design style - CMOS design style - Design rules - Need for design rules - Mead Conway design rules for the silicon gate nMOS process - CMOS n well / p well lambda based design rules - Simple layout examples. (7)

Sheet resistance - Resistance estimation - Capacitance estimation - Driving large capacitive loads. (3)

**nMOS AND CMOS CIRCUIT AND LOGIC DESIGN:** Switch logic- Pass transistor and transmission gate - Gate logic - Other forms of CMOS logic - Dynamic CMOS logic - Clocked CMOS logic - Precharged domino CMOS logic - Structured design - Simple combinational logic design examples - Parity generator - Multiplexers - Clocked sequential circuits - Two phase clocking - Charge storage - Dynamic register element - nMOS and CMOS - Dynamic shift register - Semistatic register - JK flip flop (8)

**SUBSYSTEM DESIGN PROCESS:** General arrangement of a 4-bit arithmetic processor - Design of a 4 bit shifter - Design of a ALU subsystem - Implementation of ALU functions with an adder - Carry look ahead adder – Multipliers - Serial parallel multipliers - Pipelined multiplier array. (7)

**Total 42**

### TEXT BOOKS:

1. Douglas A Pucknell, and Kamran Eshraghian, "Basic VLSI design", Prentice Hall of India, New Delhi, Third Edition, 2004.
2. Neil H E Weste and Kamran Eshraghian, "Principle of CMOS VLSI design: A System Perspective", Pearson Education, Second Edition, 2004.

### REFERENCES:

1. Jan M Rabaey, Chandrakasan A, Nikolic B, " Digital Integrated Circuits", Pearson Education, New Delhi, Third Indian Reprint, 2004. / Prentice Hall of India, New Delhi.
2. Amar Mukherjee, "Introduction to nMOS and CMOS VLSI system design", Prentice Hall, USA, 1986.
3. Wayne Wolf, "Modern VLSI Design: Systems on Silicon", Third Edition, Pearson Education Indian Reprint, New Delhi, 2006.
4. Eugene D Fabricus, "Introduction to VLSI Design", McGraw Hill International Edition, 1990.

## 08E010 ANALOG VLSI DESIGN

3 0 0 3

**DEVICE MODELLING:** Introduction to Analog Design-MOS device model-DC, small signal and large signal model. Diode model- DC, small signal and high frequency model.BJT: DC small signal and high frequency model. Passive components in MOS technology. (7)

**BASIC BUILDING BLOCKS:** Switches, Active Resistors, Current Mirrors: Types of Current mirrors-Simple,Widlar,Wilson and Cascode-Active loads, Voltage and Current References Widlar Current Source, Band Gap Referenced Circuits. (7)

**AMPLIFIERS (BJT & MOS):** Single stage amplifiers-Multistage Amplifiers:Darlington, Cascode and Differential Amplifiers Frequency response of Amplifiers: CE, CS, Cascode and Differential Amplifiers, Gilbert Multiplier cell. (7)

**OPERATIONAL AMPLIFIER:** Bipolar Operational Amplifier, Design Considerations, Basic Two stage MOS Opamp-Output stages Frequency response and Frequency Compensation,Comparators- charactersitic and two stage comparators. (7)

**SWITCHED CAPACITOR CIRCUITS:** General Considerations, Sampling Switches, Switched Capacitor Amplifier, Switched Capacitor Integrator. (7)

**D/A AND A/D CONVERTERS:** Data Converter fundamentals,DAC and ADC specifications, Charge scaling DAC's, Pipeline DAC's-Pipeline ADC and Oversampling ADC. (7)

**Total 42**

### TEXT BOOKS:

1. Phillip E Allen & Douglas R Holberg, "CMOS Analog Circuit Design", Oxford University Press 2002, First Indian Edition, 2006.

2. Grey, Hurst, Lewis and Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons Inc, Fourth Edition 2001
3. Jacob Baker R, Harry Li, David E Boyce, "CMOS Circuit Design, Layout and Simulation", IEEE Press, 1998.

**REFERENCES:**

1. David A John, Ken Martin, " Analog Integrated Circuit Design" John Wiley & Sons, 2002.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, First Edition, New Delhi, 2002.

**08E011 MIXED SIGNAL VLSI DESIGN**

**3 0 0 3**

**BASIC ANALOG BUILDING BLOCKS:** Current mirrors – Voltage sources/references – Voltage amplifiers – Transconductance and Transresistance amplifiers – Operational amplifiers – Comparators – Multipliers. (7)

**INTRODUCTION TO ACTIVE FILTERS and SWITCHED CAPACITOR FILTERS:** Active RC Filters for monolithic filter design : First and Second order filter realizations - Universal active filter (KHN) – Self tuned filter – Programmable filters – Switched capacitor filters: Switched capacitor resistors – amplifiers – comparators – sample and hold circuits – Integrator – Biquad. (9)

**CONTINUOUS TIME FILTERS and DIGITAL FILTERS:** Introduction to Gm-C filters – bipolar transconductors – CMOS Transconductors using Triode transistors, active transistors – BiCMOS transconductors – MOSFET\_C Filters – Tuning Circuitry – Dynamic range performance – Digital Filters: Sampling - decimation – Interpolation – Implementation of FIR and IIR filters. (8)

**DIGITAL TO ANALOG and ANALOG TO DIGITAL CONVERTERS:** Non-idealities in the DAC – Types of DAC's: Current switched, Resistive, Charge redistribution (capacitive), Hybrid, segmented DAC's – Techniques for improving linearity – Analog to Digital Converters: quantization errors – non-idealities – types of ADC's: Flash, two step, pipelined, successive approximation, folding ADC's. (9)

**SIGMA DELTA CONVERTERS:** Over sampled converters – Over sampling with out noise and with noise – Implementation imperfections – First order modulator – Decimation filters – Second order modulator – Sigma delta DAC and ADC's. (5)

**MIXED LAYOUT:** CMOS design rules – Layout of CMOS – BJT – Capacitors – Resistors – Mixed layout issues: Floor planning, power supply and ground, fully differential matching, Guard rings and shielding. (4)

**Total 42**

**TEXT BOOKS:**

1. David A Johns, Ken Martin, " Analog Integrated Circuit Design" John Wiley and Sons, 2005
2. Baker R J, Li H W, and Boyce D E, "CMOS: Circuit Design, Layout and Simulation", Prentice Hall of India, 2005

**REFERENCES:**

1. Phillip Allen and Douglas Holmberg, "CMOS Analog Circuit Design", second edition, Oxford University Press, 2004.
2. Rudy van de Plassche, "Integrated Analog-to-Digital and Digital –to-Analog Converters", Springer India, 2005.
3. Benhard Razavi, "Data Converters", Kluwer publishers, 1999.
4. Antoniou, "Digital filters analysis and design", Tata McGraw Hill, New Delhi, 1998.

**08E012 BIOMEDICAL INSTRUMENTATION**

**3 0 0 3**

**BASIC PHYSIOLOGY:** Cells and their structures - Transport of ions through cell membrane - Resting and excited state transmembrane potential - Action potential - Propagation of Bioelectric potential - Nervous system - Physiology of muscles - Heart and Blood circulation - Respiratory system - Urinary system. (5)

**ELECTRODES AND TRANSDUCERS:** Basic electrode theory - Micro electrodes - Skin surface electrodes - Needle electrodes - Equivalent circuit - Electrode materials - Chemical electrodes - Reference electrodes - The pH electrode - Blood gas electrode - Active transducers and passive transducers - Strain gauges - Thermistor - Biomedical applications. (5)

**SIGNAL CONDITIONERS:** Instrumentation amplifiers - Current amplifiers - Isolation amplifier - Need for filters - Low pass, High pass and Band pass active filters - Notch filters - Heated stylus and ink pen recorders. (5)

**DIAGNOSTIC EQUIPMENTS I:** Electrical and mechanical activities of the heart - Typical Electrocardiogram (ECG) - Electrocardiograph - Bipolar and unipolar leads - Einthoven triangle - Electrical activities of the brain - Electroencephalogram (EEG) - Various rhythms - EEG equipment - Muscle response - Electromyograph (EMG) - Nerve Conduction velocity measurements - Intensity - Duration characteristics. (5)

**DIAGNOSTIC EQUIPMENTS II:** Spirometer - X-ray imaging - Radio fluoroscopy - Image Intensifiers - Angiography - Endoscopy - Diathermy - Laser and its application. (5)

**BIOTELEMETRY AND PATIENT SAFETY:** Need for biotelemetry - Elements of telemetry system - Radio telemetry system - Physiological signals used in telemetry - TDM and FDM - Implantable units - Physiological effects of electrical current - Shock hazards from electrical equipments - Electrical accidents and their prevention. (6)

**PHYSIOLOGICAL ASSIST DEVICES:** Need for pacemakers - Pacemaker parameters and circuits - Demand pacemakers - Different modes of operation - DC defibrillator - Artificial heart valves - Heart lung machines - Artificial lung machines - Artificial kidney machine - Nerve and Muscle stimulator - continuous patient monitoring system. (6)

**COMPUTER APPLICATIONS:** Data acquisition systems - Analysis of ECG signals - Computerised Axial Tomography (CAT) Scanner - Ultrasonic scanner - Magnetic resonance imaging - Computer based patient monitoring system - Introduction to expert system and hospital management. (5)

**Total 42**

**TEXT BOOKS:**

1. Khandpur R S, "Handbook on Biomedical Instrumentation", Tata McGraw Hill Company, New Delhi, Second Edition, 2003.
2. Joseph J Carr and John M Brown, " Introduction to Biomedical Equipment Technology", Pearson Education, New Delhi Fourth, Indian Reprint 2003.

**REFERENCES:**

1. John G Webster, Ed.' "Medical Instrumentation Application and Design", Third Edition, John Wiley & Sons, 1999.
2. Leslie Cromwell, Fred J Weibell, and Erich A Pfeiffer, "Bio-medical Instrumentation and Measurements", Pearson Education, New Delhi, First Indian Reprint 2003. / Prentice Hall of India, New Delhi.

## **08E013 EMBEDDED SYSTEMS DESIGN**

**3 0 0 3**

**INTRODUCTION TO EMBEDDED SYSTEM:** An embedded system, functional building block of embedded system, Characteristics of embedded system applications, Challenges in embedded system design, embedded system design processes. (6)

**ARCHITECTURE OF EMBEDDED SYSTEM:** Computer architecture taxonomy, CPUs – programming input and output, Supervisor mode, exceptions & traps, Coprocessors, memory system mechanisms - CPU bus - memory devices - I/O devices - component interfacing - Assembly and linking - basic compilation techniques. (10)

**OS FOR EMBEDDED SYSTEMS:** Introduction to RTOS, multiple tasks and multiple processes, context switching, operating system, scheduling policies, interprocess communication mechanisms. Introduction to  $\mu$ C/ OS II (10)

**PERFORMANCE ISSUES OF EMBEDDED SYSTEMS:** CPU Performance, CPU Power consumption, Analysis and optimization of execution time, program size, energy and power, Evaluating operating system performance, power optimization strategies for processes, Hardware accelerators. (7)

**DESIGN & IMPLEMENTATION:** Development and debugging, manufacturing Testing, Program validation and testing, Need of Distributed embedded architecture, I<sup>2</sup> C Bus, CAN Bus, Design examples: GPS Moving map, Personal Digital Assistant, Elevator controller. (9)

**Total 42**

**TEXT BOOKS:**

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", The Morgan Kaufmann Series in Computer Architecture and Design, Harcourt Asia Pvt Ltd, 2001.
2. Rajkamal, "Embedded Systems", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2003.

**REFERENCES:**

1. David E Simon, "An Embedded software primer", Pearson education India, New Delhi, 2004.
2. Sriram V Iyer, Pankaj Gupta, "Embedded Real-time Systems Programming", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2004

## **08E014 ADVANCED MICROPROCESSORS AND MICROCONTROLLERS**

**3 0 0 3**

**8086 MICROPROCESSOR:** Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set. (7)

**80286 MICROPROCESSOR:** Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features. (8)

**80386, 80486 PROCESSORS:** 80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors. (7)



**PENTIUM MICROPROCESSOR:** Introduction – Architecture – Special Pentium registers – Memory management. (6)

**PIC MICROCONTROLLER:** Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation. (7)

**PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES:** PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I<sup>2</sup>C Bus operation (7)

**Total 42**

**TEXT BOOKS:**

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium Processor Architecture, Programming and Interfacing", Prentice Hall of India, New Delhi, Sixth Edition, 2003 / Pearson Education, New Delhi.
2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", Mc Graw Hill, New Delhi, Second Edition, 1992.
3. John B Peatman, "Design with PIC Microcontroller, McGraw Hill, Singapore, First Reprint, 2001

**REFERENCES:**

1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer based system design", UBS, New Delhi, Second Reprint, 1995.
2. Myke Pred ko, "Programming and Customising the PIC Microcontroller, "McGraw Hill, USA, 1998.

## 08E015 PERSONAL COMPUTER SYSTEMS

**3 0 0 3**

**PC PROCESSOR:** 8088 Architecture - Addressing modes - Instruction set - Features of Pentium processors. (7)

**AT ARCHITECTURE:** System units - Task allocations of system board - Timer - DMA and interrupt controller - Memory map - I/O map - AT bus. (ISA) specifications - PCI bus - Extended memory and Expanded memory. (7)

**PERIPHERAL INTERFACE:** Keyboard - Speaker - Printer - Display adapters - VGA standard - Floppy disk and hard disk formats - CD ROM structure – USB Basics. (8)

**ASSEMBLY LANGUAGE PROGRAMMING:** Program Development stages - Macro Assembler - Directives (real mode only) - Linker - Debugger. (7)

**STRUCTURE OF MS-DOS:** BIOS - DOS kernel - Command processor - Boot record - File directory - MS-DOS booting process - Program segment prefix - COM and EXE files - BIOS and DOS interrupts - Structure of device drivers. (7)

**WINDOWS:** Structure of window systems - Windows 98 - System architecture - Device drivers for windows - Virtual memory management - Windows based applications - MS-DOS based applications. (6)

**Total 42**

**TEXT BOOKS:**

1. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", Second Edition, McGraw Hill, 1999.
2. Mathivanan N, "Microprocessors, PC Hardware and Interfacing", Prentice Hall of India, New Delhi, 2003.

**REFERENCES:**

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Processor Architecture, Programming and Interfacing", Prentice Hall of India, Fourth Edition, 1997/Pearson Education.
2. Ray Duncan, "Advanced MSDOS Programming", Second Edition, BPB Publications, 1994.
3. IBM PC/AT Technical Reference Manual, IBM Corporation, USA 1982.
4. Russel Borland, "Microsoft Windows 98", Microsoft Press Publications, 1997.

## 08E016 ADVANCED COMPUTER ARCHITECTURE

**3 0 0 3**

**INTRODUCTION:** Computer architectural classification: Flynn's classification – Data flow versus Control flow computers – Parallelism in uniprocessor systems – Balancing of subsystem bandwidth – Parallel processing applications. (3)

**MEMORY AND INPUT/OUTPUT SUBSYSTEMS:** Hierarchical Memory Structure: Memory hierarchy – Optimisation – Addressing schemes for main memory – Multiple module memories – Memory interleaving – Virtual Memory System: Concepts – Paged Memory System – Segmented memory System – Memory with Paged Segments – Memory allocation and Management: Classification of memory Policies – Optimal Load Control – Memory Management Policies – Cache Memory and Management: Characteristics – Cache Memory Organisation – Fetch and Main Memory Update Policies – Block Replacement Policies – Performance evaluation and enhancement – Input Output Subsystems: Characteristics – Interrupt Mechanisms and Special Hardware – I/O Processors and I/O Channels. (9)

**PIPELINING AND VECTOR PROCESSING:** Principles of pipelining – Instruction and Arithmetic pipelines – Instruction prefetch and branch handling – Data buffering and Busing structures – Internal forwarding and Register tagging – Hazard detection and resolution – Job sequencing and Collision prevention – Vector Processing: Characteristics – Pipelined Vector Processing methods – Vectorization and optimization methods. (7)

**ARRAY PROCESSING:** SIMD Array Processors – Masking and data routing mechanisms – Inter PE communications – Interconnection networks – Parallel Algorithms for Array Processors – Associative Array Processing. (7)

**MULTIPROCESSOR ARCHITECTURE:** Functional structures: Loosely coupled multiprocessors – Tightly coupled multiprocessors – Processor characteristics for multiprocessing – Multiprocessor scheduling strategies – Interconnection networks– Parallel memory organization – Parallel Algorithms for Multiprocessors (8)

**INTRODUCTION TO RISC ARCHITECTURE:** Instruction execution characteristics – Instruction execution charts – Register files – Register optimization – Reduced Instruction Set Architecture – RISC pipelining – RISC versus CISC. (8)

**Total 42**

**TEXT BOOKS:**

1. Hwang K, and Briggs F A, "Computer Architecture and Parallel Processing", McGraw–Hill, New Delhi, 1989.
2. Stallings W, "Computer Organization and Architecture", Pearson Education, New Delhi, 2006, Seventh edition.

**REFERENCES:**

1. Patterson D A and Hennessy J L, "Computer Organisation and Design: The Hardware/Software Interface", Morgan Kaufmann Publishers, Third edition, 2005.
2. Hwang K, "Advanced Computer Architecture – Parallelism, Scalability and Programmability", Tata McGraw–Hill, New Delhi, 2006.

## **08E017 ADVANCED DATA STRUCTURES**

**3 0 0 3**

**INTRODUCTION:** Algorithm – analysis of algorithms – best case and worst case complexities, analysis of some algorithms using simple data structures, Amortized time complexity. (4)

**SORTING:** Insertion sort, selection sort, shell sort, bubble sort, quick sort, heap sort, merge sort, radix sort – Algorithms and their time complexity. (4)

**SEARCHING:** Linear Search, Binary search. (2)

**HASHING:** Hash function – separate chaining – open addressing – linear probing – quadratic probing – double hashing - rehashing. (4)

**BINARY SEARCH TREES:** Searching – Insertion and deletion of elements – Analysis. (3)

**AVL TREES :** Definition – Height – Searching – insertion and deletion of elements, AVL rotations – Analysis. (4)

**MULTIWAY SEARCH TREES:** Indexed Sequential Access – m-way search trees – B-Tree – Searching, insertion and deletion - B+ trees - Tries. (5)

**BINOMIAL HEAP AND FIBONACCI HEAP:** Binomial trees and binomial heaps – Operations on binomial heap – Structure of Fibonacci heaps – merge heap operations, decreasing a key and deleting a node – Bounding the maximum degree. (5)

**GRAPHS:** Definition – Representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Network representation – Graph search methods (Breadth first and depth first traversals). (5)

**DATA STRUCTURES FOR DISJOINT SETS:** Disjoint set operations, linked list representation of disjoint set, disjoint set forests, union, find, analysis. (3)

**CASE STUDY:** Google File System (GFS) Implementation (3)

**Total 42**

**REFERENCES :**

1. Thomas H Cormen, Charles E Leiserson and Ronald L Rivest "Introduction to Algorithms" , Prentice Hall, 2005.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, 2002.
3. Sahni Sartaj, "Data Structures, Algorithms and Application in C++", WCB / Mc Graw Hill, 2000.
4. Robert L Kruse and Clovis L Tondo, " Data Structures and Program design in C", Pearson Education, 2005.
5. Adam Drozdek, "Data Structures and Algorithms in C++", Vikas Publishing House, 2002.
6. URL: <http://labs.google.com/papers/gfs.html>

## 08E018 DATABASE MANAGEMENT SYSTEMS

3 0 0 3

**INTRODUCTION:** Purpose of database systems – data abstraction – data models – instances and schemas – data independence – data definition language – database manager – database users- data warehousing and ERP- over all system structure. (4)

**E-R MODEL:** E-R model – E-R diagram, reducing E-R diagram to tables-Enhanced entity relationship (EER)-subclass-superclass –specialization and generalization. (4)

**RELATIONAL MODEL:** Structure of relational databases – the relational algebra – tuple and domain relational calculus – modifying the databases. (5)

**RELATIONAL COMMERCIAL LANGUAGES:** SQL - Query – by – example, Query integrity constraints – domain constraints – referential integrity – functional dependencies –assertions – triggers. (7)

**RELATIONAL DATABASE DESIGN:** pitfalls in relational database designs – normalisation using multivalued dependencies, join dependencies. Domain-key normalform. Mapping relational data to file data directory storage, buffer management. Typical database design approach for: Airline reservation systems – Inventory control – Library information system. (10)

**FILE ORGANIZATION AND STORAGE:** Heap file-hashing techniques-indexes-B-trees and B+ trees-secondary storage devices-RAID technology-different levels of RAID. (6)

**TRANSACTION PROCESSING:** Desirable properties of transactions-concurrency control-locking techniques-concurrency control-database recovery techniques-ARIES recovery algorithm-database security and authorization-security issue access control based on granting/revoking of privileges. (6)

Total 42

### TEXT BOOKS:

1. Abraham, Siberschatz, Henry.F.Korth and Sudharshan. S, "Database System Concepts", Mc Graw Hill, New Delhi, 2002.
2. Ramez Elmasri and Shamkant Navethe, "Fundamentals of Database Systems", Pearson Education, New Delhi, 2003.
3. Raghu, Ramakrishnan, "Database Management Systems", Third edition Mc Graw Hill, New Delhi, 2004.

### REFERENCES:

1. Sumathi S, Esakkirajan S, "Fundamentals of Relational Database Management Systems", Springer-Verlag, 2007.
2. Thomas Connolly, Carolyn Begg, "Database system" Third edition, Pearson education Limited, New Delhi, 2002.
3. Jeffrey A Hoffer, Mary B Presscott, Fred R Mcfadden " Modern database Management Systems", Pearson Education, New Delhi, 2002.

## 08E019 COMPUTER NETWORKS

3 0 0 3

**INTRODUCTION:** Computer Networks – A perspective – Goals – Applications – Classification of Networks - Layered Architecture for Communication – Advantages – Examples - OSI Model – TCP/IP Model – Protocols and Protocol Data Units (PDUs). (5)

**DATA COMMUNICATION TECHNIQUES:** Data Types – Digital / Analog – Signaling Techniques - Digital / Analog – MODEM – CODEC – Error and Flow Control Techniques - Asynchronous and Synchronous Communication – Start-Stop Protocol - BISYNC – HDLC Protocols. (9)

**LOCAL AREA NETWORKS (IEEE 802) :** Topology: Star – Ring – Bus – Channel Access Techniques: FDM and TDM – CSMA – CSMA/CD – Ethernet LAN (802.3) – Switched LAN - Token BUS LAN (802.4)– Token Ring LAN (802.5) – Industrial Networking: CAN Bus – Field Bus. (12)

**NETWORKING ISSUES:** Wide Area Network (WAN) – X.25 Procedures – Datagram switching and Virtual Circuit Switching - Internetworking: internet - Routers – Gateways – Internet Protocol (IP) – IP Addresses – Classification – Special IP Addresses – Transmission Control Protocol (TCP) – Internet Applications – Examples. (11)

**NETWORK SECURITY:** Network Attacks – Firewalls – Packet Filtering – Encryption / Decryption Techniques – Public Key Cryptography – Digital Authentication – Digital Signatures. (5)

Total 42

### TEXT BOOKS:

1. Behrouz A Foruzan, "Data Communications and Networking", Third edition, Tata McGrawHill, New Delhi, 2004
2. Behrouz A Foruzan, " TCP/IP Protocol Suite", Third edition, Tata McGrawHill, New Delhi, 2006

### REFERENCES:

1. William Stallings, "Data and Computer Communication", Sixth edition, Pearson Education, New Delhi, 2000.
2. Basandra S.K, "Local area Networks", Galgotia Publications, 1993.
3. Youlu Zheng, Shakil Akhtar, "Networks for Computer Scientists and Engineers", Oxford University Press, Indian Edition, 2006.
4. Stanford H Rowe and Marsha L Schuh, "Computer Networking", Pearson Education, New Delhi, 2005.

## 08E020 COMPUTER GRAPHICS

3 0 0 3

**GRAPHICS INPUT - OUTPUT DEVICES:** Raster scan Displays - Random scan displays - Direct view storage tubes - Flat panel displays - Mouse - Track Ball - Joy Stick - Digitizers - Touch panels - LCD. (4)

**GRAPHICAL USER INTERFACE AND INTERACTIVE INPUT METHODS:** The user dialog - Input of graphical data - Input function - Interactive picture construction techniques - Virtual reality environments. (4)

**TWO DIMENSIONAL GRAPHICS:** Basic transformations - Matrix representation and homogeneous coordinates - Composite transformations - Line drawing algorithms: DDA and Bresenham's algorithms - Circle generation algorithms: Mid point circle algorithm - Point clipping - Line clipping: Cohen Sutherland algorithm - Polygon clipping: Sutherland Hodgeman algorithm - Line covering. (8)

**RASTER GRAPHICS:** Fundamentals: generating a raster image, representing a raster image, scan converting a line drawing, displaying characters, speed of scan conversion, natural images - Solid area scan conversion: Scan conversion of polygons, Y-X algorithm, properties of scan conversion algorithms - Interactive raster graphics: painting model, moving parts of an image, feed back images. (7)

**CURVES AND SURFACES:** Parametric representation of curves - Bezier curves - B-Spline curves - Parametric representation of surfaces - Bezier surfaces - Curved surfaces - Ruled surfaces - Quadric surfaces - Concatenation of two curve segments - Order of Continuity. (4)

**THREE DIMENSIONAL GRAPHICS:** 3D transformations - Viewing 3D graphical data - Orthographic, oblique, perspective projections - Hidden lines and hidden surface removal. (6)

**ANIMATION GRAPHICS:** Design of Animation sequences - Animation function - Raster animation - Key frame systems - motion specification - Morphing - Tweening. (4)

**COMPUTER GRAPHICS REALISM:** Tiling the plane - Recursively defined curves - Koch curves - C curves - Dragons - Space filling curves - Fractals - Grammar based models - Graftals - Turtle graphics - Ray tracing. (5)

Total 42

### REFERENCES:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Pearson Education, 2002.
2. Rankin John R, "Computer Graphics Software Construction", Prentice Hall., 1989.
3. Foley James D, Vandam Andries and Hughes John F, "Computer Graphics: Principles and Practice", Pearson Education, 2002.
4. William M Newmann and Robert F Sproull, "Principles of Interactive Computer Graphics", McGraw Hill, 2002.
5. Hill F S Jr., "Computer Graphics", Maxwell Macmillan, 2001.
6. Roy A Plastock and Gordon Kalley, "Theory and Problems of Computer Graphics", McGraw Hill, 2000.

## 08E021 SYSTEM SOFTWARE

3 0 0 3

**ASSEMBLERS:** General Design procedures - Design of an Assembler - data structures - format of databases - algorithm - flow chart - PASS structures - modular functions. (8)

**MACRO LANGUAGE AND MACRO PROCESSORS:** Macro instructions, features of a macro facility - implementation. (8)

**LOADERS:** Loader schemes - compile and go loaders, general load scheme - absolute loaders - direct linking loaders and their design. Other loading schemes: linking loaders, overlays, dynamic binders. (8)

**COMPILERS:** Introduction - Structure of a compiler - phases of a compiler - compiler writing tools. (3)

**LEXICAL ANALYSIS:** Role of a lexical analyzer - finite automata - regular expressions to finite automata - minimizing the number of states of a deterministic finite automata - implementation of a lexical analyzer. (5)

**PARSING TECHNIQUES:** Context free grammars - derivations and parse trees - ambiguity - capabilities of context free grammars. Top down and bottom up parsing - handles - shift reduce parsing - operator precedence parsing - recursive descent parsing - predictive parsing. (5)

**INTERMEDIATE CODE GENERATION:** Postfix notation, Quadruples, triples, indirect triples - Representing information in a symbol table - introduction to code optimization - basic blocks - DAG representation - error detection and recovery - code generation. (5)

Total 42

### REFERENCES:

1. John J Donovan, "Systems Programming", McGrawHill, 1999.
2. Dhamdhare D M, "Systems Programming", Tata McGrawHill, 2001.
3. Aho A V, Sethi R and Ullman J D, "Compilers: Principles, Techniques and Tools", Addison Wesley, Longman, 1999.
4. Dhamdhare D M, "Compiler Construction Principles and Practice", Macmillan Company, 1997.
5. Holub Allen I, "Compiler Design in C", Prentice Hall, 2001.

## 08E022 INTERNET TOOLS AND JAVA PROGRAMMING

3 0 0 3

**INTERNET TOOLS:** Major Internet Services – Net Telephony – Internet Relay Chat – Newsgroups – File Transfer Protocol (FTP) – Remote Login – Telnet, Gopher, and Veronica Clients. (3)

**OBJECT ORIENTATION IN JAVA:** Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Output - Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based Vs oriented programming - Inheritance-Reusability - Composing class - Abstract classes - Abstract Functions – Method Overloading and Method Overriding- Wrapper Classes. (8)

**PACKAGES AND INTERFACES:** Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces. (5)

**EXCEPTION HANDLING:** Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested Try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses. (3)

**MULTI THREADED PROGRAMMING:** Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock. (4)

**I/O, APPLETS:** I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods - GUI Components - Applets - Java Scripts – AWT / Swings. (12)

**INTRODUCTION TO NETWORK PROGRAMMING:** Fundamentals - Internet Addresses - Internet Protocols - DNS - Internet Services - Socket programming, UDP, TCP. (5)

**JAVA DATABASE PROGRAMMING:** JDBC – Database Connection and Table Creation – Execution of Embedded SQL Statements - ResultSet and ResultSetMetaData – Examples. (2)

Total 42

### REFERENCES:

1. Patrick Naughton and Herbert Schildt, "JAVA - The Complete Reference", Tata McGraw Hill, 1997.
2. Deitel and Deitel, "JAVA - How to Program", Prentice Hall International Inc, 2003.
3. William Stanek and Peter Norton, "Peter Norton's Guide to Java Programming", Tech Media Publications, 1997.
4. Mark Grand, "JAVA Language Reference", O'Reilly & Associates Inc., 1997.
5. Horstmann and Cornell, "Core Java", Pearson Education, 2001.
6. Kenneth Litwak, "Pure Java 2: A Code-Intensive Premium Reference", Tech Media Publications, New Delhi, 2000
7. James K L, "The Internet: A Users Guide", Prentice Hall of India, New Delhi, 2003.

## 08E023 SOFTWARE PROJECT MANAGEMENT AND QUALITY ASSURANCE

3 0 0 3

**INTRODUCTION:** Software Projects various other types of projects - Problems with software projects - an overview of project planning - Project evaluation - Project Analysis and technical planning - Project estimates - Preparation of Estimates - COCOMO model - Function Point Analysis - Putnam Model - Non-development overheads. (8)

**ACTIVITY PLANNING:** Project schedules - Sequencing and scheduling projects - Network planning models - Shortening project duration - Identifying critical activities. (8)

**RISK MANAGEMENT:** Resource allocation - Monitoring and Control - Managing people and organizing teams - Planning for small projects - Handling large projects - Divide and Conquer - Software Project survival. (8)

**SOFTWARE CONFIGURATION MANAGEMENT:** Basic functions, responsibilities, standards, configuration Management, Prototyping - Models of prototyping. (8)

**SOFTWARE QUALITY ASSURANCE:** Quality and the quality system - standards and procedures - Technical activities - components - Continuous Improvement - Software Tasks - Management responsibility - Quality System - Contract Review - Document Control - Product identification and trace ability. (7)

**CASE STUDY:** Introduction to Project Management Tools – Typical Applications. (3)

Total 42

### REFERENCES:

1. Mike Cotterell and Bob Hughes, "Software Project Management - Inclination", Tata McGraw Hill, 2001.
2. Robert K Wysocki, Robert Beck Jr and David B. Crane, "Effective Project Management", John Wiley & Sons Inc, 1995.
3. Bennatain E M, "On Time, Within Budget", John Wiley & Sons Inc, 1995.
4. Steve McConnell, "Software Project Survival Guide", Microsoft Press, 1998.
5. Gerald M Weinberg, "Quality Software Management", Volume I, Systems Thinking, Dorset House Publishing, 1997.
6. Gerald M Weinberg, "Quality Software Management", Volume II, First Order Measurement, Dorset House Publishing, 1997.
7. Pressman R S, "Software Engineering - A Practitioner's Approach" McGraw Hill Book Company, 2001.

8. Darrel Ince, "An Introduction to S/W Quality Assurance and its Implementation", Mc-Graw Hill Book Company Ltd, 1994.

## 08E024 GRID COMPUTING

3 0 0 3

**INTRODUCTION:** A vision of the Grid and its promises – Scientific Roots – Business Perspective – WS-Resource Frame Format and its meaning – Virtual Organizations and its security – Open Grid Service Architecture (OGSA) and its overview – Grid versus Distributed Computing - Grid versus Web services - Grid versus Peer to Peer (P2P). (8)

**GRID COMPUTING IN BUSINESS:** Grid taxonomy – Departmental Grids – Enterprise Grids – Open Grids and the Grid – Joining the Grid – Strategies for participation – Building an Enterprise Grid – example – Software Release Engineering on the Grid – Grid enabling a solution – Grid Infrastructure provider – Service Provider on the Grid – example – Grid for Equipment Health Monitoring. (10)

**TECHNICAL ISSUES:** High-level System Design – Analogies – The Web – Peer to Peer – Technology Areas - Data Management and Databases – Storage Management – Resource Management – Super Computers – Clusters and farms – On-demand CPU Resource – Workflow Management – Security – Internal versus External Security. (12)

**MANAGEMENT ISSUES:** Building and Selling Grid Business Case – Change and Transition Period Management – Role of Consultants – Risk Mitigation: Risk identification – Risk quantification – Risk response development – Risk response control – Fighting white space risk – White space in the Grid sector – Agile Development: Pair Programming – Test-driven Programming – The Globus Campaign System. (8)

**CASE STUDIES:** The MCNC Enterprise Grid – SUN N1 Grid Engine – LSF Suite - The NEESgrid cyber-infrastructure – The Globus Toolkit 4 Service Container. (4)

**Total 42**

### TEXT BOOK:

1. Plaszczak P and Wellner R, "Grid Computing: The savvy Manager's Guide", Elsevier, New Delhi, 2006.

### REFERENCE:

1. Joshy Joseph and Craig Fellenstein, "Grid Computing", Pearson Education, New Delhi, 2007.

## 08E025 NANO COMPUTING

3 0 0 3

**INTRODUCTION:** The development of Microelectronics – The region of Nanoelectronics - The Complexity Problem – The challenge initiated by Nanoelectronics . Basics of Nanoelectronics: Electromagnetic Fields and Photons – Quantization of Action, Charge, and Flux – Electrons behaving as waves – Electrons in potential wells – Diffusion Process. (10)

**BIOCHEMICAL AND QUANTUM-MECHANICAL COMPUTERS:** DNA Computer – Information Processing with Chemical reactions – Nanomachines – Parallel Processing. Quantum Computers – Bit and Qubit – Coherence and Entanglement – Quantum Parallelism. (8)

**PARALLEL ARCHITECTURES FOR NANOSYSTEMS:** Mono and Multiprocessor Systems – Some considerations to Parallel Processing – Influence of Delay Time – Power Dissipation - Architecture for Processing in Nanosystems: Classic Systolic Arrays – Processor with large memory – Processor array with SIMD and PIP Architectures – Reconfigurable Computers – The Teramac Concept as a Prototype. (8)

**SOFT COMPUTING AND NANOELECTRONICS:** Methods of Soft Computing – Fuzzy Systems – Evolutionary Algorithms – Connectionistic Systems – Computationally Intelligent Systems – Characteristics of Neural Networks in Nanoelectronics - Local Processing – Distributed and Fault-tolerant Storage – Self-organization. (8)

**NANOSYSTEMS AS INFORMATION PROCESSING MACHINES:** Nanosystems as Functional Machines – Information Processing as Information Modification – System Design and its interfaces – Requirements of Nanosystems. Uncertainties: Removal of Uncertainties by Nanomachines – Uncertainties in Nanosystems – Uncertainties in the Development of Nanoelectronics. (8)

**Total 42**

### TEXT BOOK:

1. Karl Goser et.al, "Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices", Springer, New Delhi, 2005.

## 08E026 DIGITAL SYSTEM DESIGN

3 0 0 3

**SYSTEM DESIGN USING PLDs AND CPLDs:** Structure of Standard PLDs and Complex PLDs (CPLDs) – Design of combinational and sequential circuits using PLDs and CPLDs – Design of state machines using Algorithmic State Machines (ASM) chart as a design tool. (8)

**INTRODUCTION TO FIELD PROGRAMMABLE GATE ARRAYS (FPGAs):** Types of FPGA – Xilinx XC3000 series – Logic Cell Array (LCA) – Configurable Logic Blocks (CLB) – Input/Output Blocks (IOB) – Programmable Interconnection Points (PIP) – Introduction to ACT 2 family and Xilinx SPARTAN, VIRTEX, FPGA – Design examples. (7)

**INTRODUCTION TO VHDL:** Digital System Design process – Levels of abstraction – VHDL: Design entities, Architectural body – Data types - Scalar types – Composite types – Access types – File types – Operators and expressions – Data objects. Concurrent and sequential statements: Concurrent Signal Assignment – Conditional Signal Assignment – Signal Drivers – Inertial, transport and delta delays – Sequential control – Wait-if–Case – Loop – Next – Exit – Null process – Component instantiation – Block – Generics – Assert. (10)

**SUBPROGRAMS, PACKAGES AND CONFIGURATIONS:** Functions – Procedure– Package – Package declarations – Sub program declaration – Package body – Libraries – Predefined attributes – Configuration – Behavioural, Dataflow and Structural modeling of digital circuits – Simple VHDL codes. (8)

**TESTING IN DIGITAL CIRCUITS AND DESIGN FOR TESTABILITY:** Detection and location of faults in combinational logic circuits –Stuck-at-fault model – Path sensitising method – Boolean difference method – Fault detection and location in synchronous sequential circuits – Design for testability – Adhoc techniques – Scan registers – Level Sensitive Scan Design – Boundary Scan –Built-in-self test. (9)

**Total 42**

**REFERENCES:**

1. Nelson V P, Nagale H T, Carroll B D, and Irwin J D, "Digital Logic Circuit Analysis and Design", Prentice Hall International Inc.New Jersey, 1996
2. Palmer J E and Perlman D E, "Introduction to Digital Systems", Schaum's Outline Series, Tata McGraw Hill, Delhi, 2004.
3. Robert K Dueck, "Digital Design with CPLD applications and VHDL", Thomson Asia, 2002.
4. Roth C H, "Digital Systems Design using VHDL", Thomson Asia, 2006.
5. Perry D V, "VHDL: Programming by Example", Tata McGraw-Hill Publishing Company, Fourth Edition, 2002.
6. Bhasker J, "A VHDL Primer", Third Edition, Prentice Hall of India,2006.
7. Abramovici M B, Brever and Friedman D, "Digital Systems Testing and Testable Design", Jaico Publishing House,1997.
8. Samuel C Lee," Digital Circuits and Logic Design", Prentice Hall, INC. 2001

### 04ES01 LOW POWER SYSTEM DESIGN

1. Introduction
  - a. System-level Power Estimation
  - b. System-level Power Optimization
2. Introduction
  - a. Power Management using Voltage Island Technique
  - b. Energy (Power) Management Approach by ARM
  - c. Low Power Design Example with Samsung AP based on ARM 920T
  - d. IBM Low Power Design using PowerPC
  - e. Conclusions
3. Background for Leakage Current
4. Power estimation and analysis
5. Power estimation in the algorithmic and RTL Level
6. Low Power Very Fast Dynamic Logic Circuits
7. Low Power Arithmetic Operators
8. Circuit Techniques for Dynamic Power Reduction
9. Leakage Reduction Techniques
10. Low-power & low voltage Interconnects in SoC
11. Lab Exercises and Case Studies

**Total 15**

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

### 04ES02 METHOD AND ALGORITHM FOR SYSTEM DESIGN

1. Propagation delay, circuit timing, and adder design
2. System Synthesis of Digital Systems
3. Library Binding
4. Retiming
5. Scheduling
6. Resource Sharing
7. Synchronous Logic Optimization
8. Timing issues in multi-level logic optimization
9. Lab Exercises and case Studies

**Total 15**

**REFERENCES:**

Laboratory Manual Prepared by EEE Department

## 04ES03 LOW POWER HIGH PERFORMANCE MICROPROCESSOR DESIGN

1. Circuit Design for Low Power
2. Power aware Micro architecture Design
3. Power aware Micro architecture Modeling
4. Power aware Micro architecture metrics
5. Design for low power tools and Methodologies
6. Labs and exercises

**Total 15**

### REFERENCES:

Laboratory Manual Prepared by EEE Department

## DETAIL SYLLABI FOR INDUSTRIAL TRAINING

### I. 08E100 INDUSTRY ORGANISATION STRUCTURE, SAFETY, ENVIRONMENT NEEDS

**0 15 0 4**

Plant layout - List of machine tools -Specifications-Operation done on each machine tool - Constructional arrangements of machine tools-various work holding and tool holding methods - Types of cutting tools used –Hand tools - Type of component and material of the component –Organizational structures – Industrial safety – Sales and marketing – Maintenance – Power distribution.

**Total 210**

### II. 08E200 STUDY OF CONTROL ELEMENTS & WIRING

**0 15 0 8**

Study of important BIS – Different types of wirings: House – Industrial — Study of control elements: Switches - Relay – contactor – solid state relays – circuit breakers – Types of Cables – Accessories – Cable termination.

**Total 210**

### III. 08E300 WINDING AND ELECTRONIC PRODUCT DESIGN

**0 15 0 12**

Study of different types of winding wires – Insulation materials – Stamping & Laminations – Preparation of coils – Hands on training in winding machine.

Study of different types of semiconductor devices – fabrication of simple circuits: Circuit lay out preparation – PCB fabrication – soldering – Testing.

**Total 210**

### IV. 08E400 INSPECTION AND TESTING OF PUMPS AND MOTORS

**0 15 0 8**

IS specification for motors and pump sets - List of testing instrument - Functions - foot mounting motor dimensions as per IS: 1231 - Importance of name plate and identification of name plate details - Trouble shooting of induction motors - Type of routine test of induction motor as per IS : 7538 (Performance Calculations) 1) Measurement of stator resistance 2) High voltage test 3) Measurement of insulation resistance 4) Reduced voltage test 5) No load test 6) Full load test 7) Locked rotor test 8) Starting torque and starting current 9) Pull up torque 10) Pull out torque 11) Momentary over load test 12) Temperature rise test.

Study of constructional details of Servo, stepper & SR Motors

**Total 210**

### V. 08E500 ELECTRICAL LIGHTING & QUALITY SYSTEM SKILL QUALITY SYSTEM SKILL

**0 15 0 8**

Design of electrical wiring diagram using ePLAN – Lighting system: commercial lighting – Consumer lighting – industrial Lighting – Road & landscape lighting – Flood lighting – LED lighting - Solar PV system installation and testing

### QUALITY SYSTEM SKILL

Awareness of TQM, ISO 9000,etc. - Process capability studies – Rejection analysis – Six sigma applications – Calibration needs – Calibration authorities – Records – Charts – Applications – Form error understanding and verification- Case studies in quality systems.

**Total 210**



## **VI. 08E600 AUTOMATION COMPONENTS**

**0 15 0 12**

### **SENSORS AND TRANSDUCERS LAB**

Sensors lab - Study of different types of sensors: Inductive – capacitive –Photo electric – Magnetic - Encoder – Interfacing with controllers.

PLC Lab: Study of PLCs and automation components -Development of simple projects using PLC and Testing –Study of different types of Drives – Interfacing of drives with PLC.

**Total 210**

## **VII. 08E700 MANAGERIAL SKILLS, SOFT SKILLS AND HRM, GENERATION OF CREATIVE & INNOVATIVE IDEAS**

**0 15 0 8**

Executive Skills-Group Discussions-Communication Skills-Project Report preparation methods-Focus on customer needs-Visual Management-Scheduling systems-Maintenance Management-Vendor Developments-Model Preparations-Production, Planning & Controls-Storage & Inventory Management-Supply Chain Management-Lean Methods-Wastage Identifications-Equipment Up Time-Kaizen & Lean Practices, human Resource Management Skills-Innovation & Adaptation Skills- Creative Skills- Patent Right knowledge-Competitive Skills- Interview focusing skills- Product Development Skills- Reverse Engineering Skills- Concurrent Engineering Skills-Prototyping Skills-Costing Skills- Analyzing Skills- Marketability Analysis Skills.

**Total 210**

## **VIII. 08E800 INDUSTRIAL VISIT AND COLLOQUIUM I**

**0 15 0 4**

Industrial profile - Product range - Catalogue - Infrastructure - Turn over - Quality system - Labor force - Industrial structure - Location - Layout - ISO 9000 - Material handling system - R & D - Product development - Manufacturing system - Advanced quality systems - Types of industry 1) Auto mobile 2) Foundry 3) Steel 4) Cement 5) Machining 6) Forging 7) Fabrication 8) Electrical. -Industry Lecture-Seminars-Quiz programmes

**Total 210**

## **IX. 08E900 INDUSTRIAL VISIT AND COLLOQUIUM II**

**0 15 0 4**

Visiting external industries and acquiring followed - Focus on customer – Visual management – Scheduling system – Maintenance management – Model preparation – Vendor development – Production planning and control – Storage and inventory management - Supply chain management – Layout and material handling system – Orderliness – Safety and environment – Equipment uptime- Study and application of KAIZEN, Lean practices, Value engineering, Zero defects, Wastage identification, Productivity improvement, Continuous Productivity improvement – Reverse engineering – Poka-Yoke, ISO system needs, Knowledge on TQM, TPM and applications

**Total 210**