DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

B.Tech. – Electrical and Electronics Engineering (Full Time)

3rd to 8th Semester Revised Curriculum & Syllabus for 2010 – 2014 Batch Onwards

	Semester – III				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER31	Mathematics – III	3	1	0	4
BEEER32	Analog Devices & Circuits	3	0	0	3
BEEER33	Thermodynamics and Fluid Mechanics & Machinery	3	0	0	3
BEEER34	Introduction to Data Structures	3	0	0	3
BEEER35	Electric Circuits	3	1	0	4
BEEER36	Electrical Machines - I	3	1	0	4
Practical					
BEEERP31	Electric & Electronics Circuits Lab	0	0	3	1
BEEERP32	Electrical Machines Lab – I	0	0	3	1
				Total	**23**

	Semester – IV				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER41	Numerical Methods	3	1	0	4
BEEER42	Digital Electronics & HDL Programming	3	1	0	4
BEEER43	Electrical Measurements & Instrumentation	3	0	0	3
BEEER44	Networks & Systems	3	1	0	4
BEEER45	Electrical Machines – II	3	1	0	4
BEEER46	Electromagnetic Field Theory	3	1	0	4
Practical					
BEEERP41	Digital Design Lab	0	0	3	1
BEEERP42	Electrical Machines Lab – II	0	0	3	1
				Total	**25**

	Semester – V				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER51	Object Oriented Programming	3	0	0	3
BEEER52	Linear & Digital Integrated Circuits	3	0	0	3
BEEER53	Control Systems	3	1	0	4
BEEER54	Transmission & Distribution	3	1	0	4
BEEER55	Design of Electrical Machines*	3	1	0	4
BEEER56	Communication Engineering	3	0	0	3
Practical					
BEEERP51	Linear & Digital Integrated Circuits Lab	0	0	3	1
BEEERP52	Control & Instrumentation Lab	0	0	3	1
				Total	**23**

*** The end semester examination will be conducted as Practical Examination with External and Internal Examiners.**

	Semester - VI				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER61	Principles of Management	3	0	0	3
BEEER62	Microprocessor and Microcontroller	3	0	0	3
BEEER63	Power System Analysis	3	1	0	4
BEEER64	Power Electronics	3	1	0	4
BEEER65	Introduction to Digital Signal Processing	3	1	0	4
BEEER66	Power System Protection & Switchgear	3	0	0	3
Practical					
BEEERP61	Microprocessor & Microcontroller Lab	0	0	3	1
BEEERP62	Power Electronics Lab	0	0	3	1
				Total	**23**

	Semester – VII				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER71	Basics of Embedded Systems Design	3	0	0	3
BEEER72	Power System Operation and Control	3	1	0	4
BEEER73	Electrical Drives & Control	3	0	0	3
BEEER74	High Voltage Engineering	3	0	0	3
BEEERE01 BEEERE02 BEEERE03 BEEERE04 BEEERE05	Elective – I	3	0	0	3
BEEERE06 BEEERE07 BEEERE08 BEEERE09 BEEERE10	Elective – II	3	0	0	3
Practical					
BEEERP71	Digital Simulation Lab	0	0	3	1
BEEERP72	Comprehensive Test	0	1	0	1
BEEERP73	Project Work – Phase-I	0	0	6	2
				Total	**23**

	Semester - VIII				
Code	**Course Title**	**L**	**T**	**P**	**C**
BEEER81	Entrepreneurship Development	3	0	0	3
BEEER82	Electrical Energy Generation, Utilization & Conservation	3	0	0	3
BEEERE11 BEEERE12 BEEERE13 BEEERE14 BEEERE15	Elective –III	3	0	0	3
BEEERE16 BEEERE17 BEEERE18 BEEERE19 BEEERE20	Elective – IV	3	0	0	3
Practical					
BEEERP81	Project Work – Phase-II	0	0	21	6
				Total	**18**

Total Credits (3rd to 8th Semesters): 135

LIST OF ELECTIVES

ELECTIVE- I

S.No	Code	Course Title	L	T	P	C
1.	BEEERE01	Advanced Control Theory	3	0	0	3
2.	BEEERE02	Computer Architecture & Organization	3	0	0	3
3.	BEEERE03	Operations Research	3	0	0	3
4.	BEEERE04	Power System Transients	3	0	0	3
5.	BEEERE05	Principles of Robotics	3	0	0	3

ELECTIVE -II

6.	BEEERE06	Digital Image Processing	3	0	0	3
7.	BEEERE07	Neural Networks and Fuzzy Logic	3	0	0	3
8.	BEEERE08	Power Quality	3	0	0	3
9.	BEEERE09	Computer Networks	3	0	0	3
10.	BEEERE10	Web Technology	3	0	0	3

ELECTIVE -III

11.	BEEERE11	Total Quality Management	3	0	0	3
12.	BEEERE12	Bio Medical Measurements & Instrumentation	3	0	0	3
13.	BEEERE13	HVDC Transmission	3	0	0	3
14.	BEEERE14	Programmable Logic Controllers	3	0	0	3
15.	BEEERE15	Operating Systems	3	0	0	3

ELECTIVE- IV

16.	BEEERE16	Non Conventional Energy sources	3	0	0	3
17.	BEEERE17	Flexible AC Transmission System	3	0	0	3
18.	BEEERE18	Introduction to VLSI	3	0	0	3
19.	BEEERE19	Special Electrical Machines	3	0	0	3
20.	BEEERE20	MEMS	3	0	0	3

BEEER31	MATHEMATICS – III	3	1	0	4

UNIT-I Partial Differential Equations 9-Hours

Formation – Solutions of standard types of first order equations – Lagrange's equation – Linear partial differential equations of second order and higher order with constant coefficients.

UNIT-II Fourier Series 9-Hours

Dirichlet's conditions- General Fourier series-Half range Sine and Cosine series -Parsevals's identity – Harmonic Analysis.

UNIT-III Boundary Value Problems 9-Hours

Classification of second order linear partial differential equations – solutions of one-dimensional wave equation,one-dimensional heat equation – steady state solution of two-dimensional heta equation – Fourier series solutions in Cartesian coordinates.

UNIT-IV Laplace Transforms 9-Hours

Transforms of simple functions- Basic operational properties- transforms of derivative and integrals-Initial and Final value theorems- Inverse Transforms- Convolution theorem-Periodic functions-Applications of Laplace transform for solving linear ordinary differential equations upto second order with constant coefficients and simultaneous equations of first order with constant coefficients.

UNIT-V Fourier Transforms 9-Hours

Statement of Fourier integral theorem - Fourier Transforms pairs- Fourier Sine and Cosine Transforms- Properties- Transforms of simple functions-Convolution theorem- Parseval's Identity

Tutorials = 15
Total no. of Hours = 60

Text Books:

1. B.S Grewal, "Higher Engineering Mathematics", 39th Edn., Khanna Publishers, New Delhi 2007.
2. E.Kreyszig "Advanced Engineering Mathematics" 8th Edn., Wiley India ,2007

Reference Books:

1. P.Kandaswamy, K.Thilakavathy and Gunavathy "EngineeringMathematics Vol II&III", S.Chand & Co Publishers, New Delhi, 2008.
2. S.Narayanan, T.K.Manikavachagam Pillai, and G.Ramanaiah, "Advanced Mathematics for Engineering Students", Vol.I, 2nd Edn., 2002.
3. M.K.Venkataraman,"Engineering Mathematics", Volumes III – A&B, National Publishing Company, Chennai – 2002.

BEEER32	ANALOG DEVICES & CIRCUITS	3	0	0	3

UNIT – I PN DIODE AND ITS APPLICATIONS **9-Hours**

PH junction diode-VI characteristics – Rd, temperature effects – Drift ad diffusion currents – switching – Rectifiers: HWR, FWR, BR, filters-Zener diode – VI characteristics, Regulators (series and shunt), LED, LCD characteristics and applications.

UNIT – II BJT AND ITS APPLICATIONS **9-Hours**

Junction transistor – Transistor construction – Input and output characteristics – CE, CB and CC configurations – hybrid model – Analytical expressions – switching – RF application – Power transistors – Opto couplers.

UNIT – III FET AND ITS APPLICATIONS **9-Hours**

FET – VI characteristics, VP, JFET – small signal model – LF and HF equivalent circuits – CS and CD amplifiers –cascade and cascade – Darlington connection – MOSFET - Characteristics – enhancement and depletion.

UNIT – IV AMPLIFIERS AND OSCILLATORS **9-Hours**

Differential amplifiers: CM and DM – condition for ofc-feedback amplifiers – stability – Voltage / current, series / shunt feedback – oscillators – LC, RC, crystal.

UNIT – V PULSE CIRCUITS **9-Hours**

RC wave shaping circuits – Diode clampers and clippers – Multivibrators – Schmitt triggers – UJT based saw tooth oscillators.

Total no. of Hours = 45

TEXT BOOK

1.Paynter, “Introductory lectronic devices and circuits, 2006, PHI
2.David Bell “Electronic Devices and Circuits” 2007, PHI.

REFERENCES

1.Theodre F.Boghert, “Electronic Devices & Circuits” Pearson Education, VI Edition, 2003
2. Rashid, “Microelectronic circuits” Thomson Publication, 1999
3. B.P.Singh & Rekha Sing, “Electronic Devices and Integrated Circuits” Pearson Education, 2006.

BEEER33	THERMODYNAMICS AND FLUID MECHANICS & MACHINERY	3	0	0	3

PART – A THERMODYNAMICS 50 Marks

UNIT-I SYSTEM AND LAWS OF THERMODYNAMICS 6-Hours

Closed and open systems – first law – second law – reversibility – Entropy –Equilibrium-– heat and work transfers- entropy change – Carnot's Theorem – Heat conduction – basic concepts of conduction , convection & radiation.

UNIT-II POWER CYCLES AND INTERNAL COMBUSTIONS ENGINES 6-Hours

Carnot's cycle – Otto cycle – diesel cycle – Air standard efficiency – Two stroke and four-stroke engines – SI and CI engines.

UNIT-III STEAM BOILERS AND TURBINES 6-Hours

Boilers and accessories – layout of thermal power plant – steam turbines – impulse and reaction turbine –basic operations only.

PART – B FLUID MECHANICS & MACHINERY 50 Marks

UNIT-I FLUID PROPERTIES 6-Hours

Mass density – specific weight – viscosity – surface tension – capillary compressibility– Power required to overcome friction in bearings- Bernoulli's equation- venturi meter – Darcy's equation.

UNIT-II HYDRAULIC MACHINERY 6-Hours

Classification of turbines — Kaplan turbine – Pelton wheel turbine – Francis turbine – qualitative treatment only.

UNIT-III PUMPS 6-Hours

Types of pumps – positive displacement pumps – Centrifugal pumps – Construction details – Pumps in series and parallel.

PRACTICAL DEMONSTRATION 9- Hours

THERMAL LAB

Performance test on IC Engine .

Valve Timing.

FLUID MACHINERY LAB

1. Performance study of turbines.
2. Performance study of pumps.

TEXT BOOKS: **Total no. of Hours = 45**

1. T. Roy Choudhury, "Basic Engineering Thermodynamics", Tata McGraw Hill Publishing Co. Ltd., 1997.
2. R.K.Rajput, "Fluid Mechanics and Hydraulic Machinery", S.Chand Publication, 2003.

BEEER34	INTRODUCTION TO DATA STRUCTURES	3	0	0	3

UNIT – I INTRODUCTION TO DATA STRUCTURES **9 Hours**

Abstract data types - Sequences as value definitions - Data types in C - Pointers in C -Data structures and C - Arrays in C - Array as ADT - One dimensional array -Implementing one dimensional array - Array as parameters - Two dimensional array -Structures in C - Implementing structures - Unions in C - Implementation of unions -Structure parameters - Allocation of storage and scope of variables.Recursive definition and processes: Factorial function - Fibonacci sequence - Recursion in C - Efficiency of recursion.

UNIT – II STACK, QUEUE AND LINKED LIST **9 Hours**

Stack definition and examples – Primitive operations – Example - Representing stacks in C - Push and pop operation implementation.Queue as ADT - C Implementation of queues - Insert operation - Priority queue - Array implementation of priority queue.Inserting and removing nodes from a list-linked implementation of stack, queue and priority queue - Other list structures - Circular lists: Stack and queue as circular list -Primitive operations on circular lists. Header nodes - Doubly linked lists - Addition of long positive integers on circular and doubly linked list.

UNIT - III TREES **9 Hours**

Binary trees: Operations on binary trees - Applications of binary trees - Binary tree representation - Node representation of binary trees - Implicit array representation of binary tree – Binary tree traversal in C - Threaded binary tree - Representing list as binary tree - Finding the K^{th} element - Deleting an element.Trees and their applications: C representation of trees - Tree traversals - Evaluating an expression tree - Constructing a tree.

UNIT – IV SORTING AND SEARCHING **9 Hours**

General background of sorting: Efficiency considerations, Notations, Efficiency of sorting. Exchange sorts: Bubble sort; Quick sort; Selection sort; Binary tree sort; Heap sort. Heap as a priority queue - Sorting using a heap-heap sort procedure - Insertion sorts: Simple insertion - Shell sort - Address calculation sort - Merge sort -Radix sort.Sequential search: Indexed sequential search - Binary search - Interpolation search.

UNIT - V GRAPHS **9 Hours**

Application of graph - C representation of graphs - Transitive closure - Warshall's algorithm – Shortest path algorithm - Linked representation of graphs - Dijkstra's algorithm - Graph traversal - Traversal methods for graphs - Spanning forests - Undirected graph and their traversals - Depth first traversal - Application of depth first traversal - Efficiency of depth first traversal - Breadth first traversal - Minimum spanning tree - Kruskal's algorithm - Round robin algorithm.

TEXT BOOK **Total no. of Hours = 45**

1. Aaron M. Tenenbaum, Yeedidyah Langsam, Moshe J. Augenstein, 'Data structures using C', Pearson Education, 2004 / PHI.

REFERENCE BOOKS

1.E. Balagurusamy, 'Programming in Ansi C', Second Edition, Tata McGraw Hill Publication, 2003.

2.Robert L. Kruse, Bruce P. Leung Clovis L.Tondo, 'Data Structures and Program Design in C', Pearson Education, 2000 / PHI.

BEEER35	ELECTRIC CIRCUITS	3	1	0	4

UNIT-I BASIC CIRCUIT CONCEPTS 9-Hours

Lumped circuits -Ideal and Practical sources – Independent and Dependent sources v-i relationships of circuits elements of R, L and C – source Transformation – Mesh and node analysis with linearly independent and dependent sources-concepts of super mesh and super node.

UNIT-II SINGLE PHASE AC CIRCUITS & COUPLED CIRCUITS 9-Hours

Review of AC fundamentals-Sinusoidal steady state analysis of simple series and parallel circuits – power and power factor- analysis by mesh current and node voltage methods - Series resonance and Parallel resonance. - their frequency response – Quality factor and Bandwidth – Coupled circuits - Self and mutual inductance – Coefficient of coupling – Dot Rule – Analysis of Coupled Circuits.

UNIT-III NETWORK THEOREMS 9-Hours

Superposition theorem – Thevenin's theorem – Norton's theorem - Maximum power transfer theorem - Reciprocity theorem – Compensation theorem – Substitution theorem - Millman's theorem and Tellegen's theorem - Statement, illustration &application to DC & AC circuits.

UNIT-IV THREE PHASE CIRCUITS 9-Hours

Three-phase systems – phase sequence– Analysis of three phase 3- wire and 4- wire circuits with star and delta connected loads ,balanced /unbalanced –neutral shift- Phasor diagram of voltages & currents – Power & Power factor measurement in three phase circuits.

UNIT-V NETWORK TOPOLOGY 9-Hours

Network graphs, tree and co tree - twigs and links - concept of incidence matrix, tie set, cut set , tie set and cut set schedules- formulation of equilibrium equations in matrix form and solution-Applications to resistive networks-Duality and Dual networks.

Tutorial = 15

Total no. of Hours = 60

TEXT BOOK:

(a) Sudhakar, A. and Shyam Mohan S.P.,"Circuits and Network Analysis and Synthesis", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 3RD edition 2007

(b) William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering CircuitsAnalysis",Tata McGraw Hill publishers, 6thedition, New Delhi, (2002).

REFERENCES BOOKS:

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi,(1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, TataMcGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, NewDelhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, (2003).

BEEER36	ELECTRICAL MACHINES – I	3	1	0	4

UNIT – I BASIC CONCEPTS IN ROTATING MACHINES 9 Hours

Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits –Hysteresis and Eddy current losses. Energy in magnetic systems – Field energy & mechanical force – Single and Multiple excited systems. MMF of distributed windings – Magnetic fields in rotating machines –Generated voltages – Torque.

UNIT – II DC GENERATORS 9 Hours

Constructional features of DC machine – Principle of operation of DC generator – EMF equation – Types of excitation – No load and load characteristics of DC generators – commutation – armature reaction – Parallel operation of DC generators.

UNIT –III DC MOTORS 9 Hours

Principle of operation of DC motors-Back emf – Torque equation –Types of DC motors-Speed – Torquecharacteristics of DC motors – Starting of DC motors: 2 point starter, 3 point starter, 4 point starter – Speedcontrol – Losses and efficiency –Applications

UNIT – IV TRANSFORMERS 9 Hours

Principle of operation – Constructional features of single phase and three phase transformers – EMF equation –Transformer on No load and Load –Phasor diagram --equivalent circuit – Regulation - three phase transformer connections-parallel operation of single phase and three phase transformer- Auto transformers.

UNIT – V TESTING OF DC MACHINES & TRANSFORMERS 9 Hours

Losses and efficiency –Condition for maximum efficiency – Testing of DC machines:Brake test , Swinburne'stest, Retardation test, Hopkinson's test- Testing of transformer:polarity test,load test, open circuit and shortcircuit test, Sumpner's test – All day efficiency.

TEXT BOOKS: **Tutorial = 15**

Total no. of Hours = 60

1. Kothari.D.P and Nagrath.I.J. *Electrical Machines*, Tata McGraw Hill Publishing Co.Ltd, New Delhi,7th edition 2005
2. Dr. Murugesh Kumar K. *DC Machines & Transformers*, Vikas Publishing House Pvt Ltd., 2003.

REFERENCE BOOKS

1. Fitgerald, A.E., Charles Kingsely Jr. Stephen D.Umans, *Electric Machinery* McGraw Hill BooksCompany, 1992.
2. Hill Stephen, J. Chapman, *Electric Machinery Fundamentals*, McGraw Hill Book Co., new Delhi,1985.
3. Albert E Clayton and N N Hancock, *The performance and design of direct current Machines*, Oxford and IBH publishing company Pvt., Ltd., New Delhi 1990.

BEEERP31	**ELECTRIC & ELECTRONICS CIRCUITS LAB**	**0**	**0**	**3**	**1**

1. Verification of Ohm's law & Kirchhoff's Laws.
2. Verification of super position Theorem, Maximum power transfer theorem, Thevenin's theorem.
3. Study of Transients.
4. Resonant Circuits.
5. Study of CRO.
6. Characteristics of BJT, JFET
7. Rectifier- Half wave, Full wave without filter
8. Full Wave Rectifier with shunt, L and Π filters.
9. Feedback Circuits.
10. LC Oscillator.
11. Power amplifier.

Total no. of Hours = 45

BEEERP32	ELECTRICAL MACHINES LAB – I	0	0	3	1

1. Open circuit characteristic and load characteristics of DC shunt generator.
2. Determination of Critical Speed of DC shunt generator.
3. Load characteristics of DC compound generator.
4. Load test on DC shunt motor.
5. Load test on DC series motor.
6. Speed Control of DC shunt motor.
7. Swinburne's Test.
8. Hopkinson's Test.
9. Load test on single-phase Transformer.
10. Open circuit and short circuit test on single-phase Transformer.
11. Separation of no load losses in a single-phase Transformer.
12. Sumpner's Test.
13. Three-phase transformer connections.
14. Scott connection.

Total no. of Hours = 45

BEEER41	NUMERICAL METHODS	3	1	0	4

UNIT-I SOLUTIONS OF EQUATIONS & EIGEN VALUE PROBLEMS 9-Hours

Method of False Position-Iteration Method-Newton-Raphson method for single variable and for simultaneous Equations with two variables-solutions of linear systems by Gaussian, Gauss-Jordan, Jacobi and Gauss-Seidal Methods _ Inverse of a Matrix by Gauss-Jordan method, Eigen value by Power and Jacobi Method.

UNIT-II INTERPOLATION 9-Hours

Newton's Divided Difference Formula, Lagrange's Polynomials – Newton's Forward and Backward Difference Formula, Stirling's and Bessel's Central Difference Formulae – Least Square Polynomial Approximation.

UNIT-III NUMERICAL DIFFRENTIATION & INTEGRATION 9-Hours

Numerical Differentiation with Interpolation Polynomials – Numerical Integration by Trapezoidal and Simpson's (both $1/3^{rd}$ &$3/8^{th}$) Rules _ two and Three Point Gaussian Quadrature Formulae – Double Integrals Using Trapezoidal and Simpson's (both $1/3^{rd}$ & $3/8^{th}$)

UNIT-IV INITIAL VALUE PROBLEMS OF ORDINARY DIFFERENTIAL EQUATIONS 9-Hours

Single step methods: Taylor's Series – Euler & Modified Euler- Runge –Kutta Method of order four for first and second order Differential equations – Multistep methods: Milne and Adam – Bashforth's Predictor and Corrector methods.

UNIT-V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9-Hours

Finite difference solution of second order ordinary differential equation – Finite difference solution for one dimensional heat equation both explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

Tutorial = 15

Total no. of Hours = 60

TEXT BOOKS:

1. S.S.SASTRY Introductory Methods of Numerical Analysis,3^{rd} Edn,PHI, New Delhi,2003.
2. P.KANDASAMY, K.THILAGAVATHY& K.GUNAVATHY Numerical Methods S.Chand &Co, New Delhi, 2001.

REFERENCE BOOKS:

1. B.S.GREWAL& J.S.GREWAL Numerical Methods in Engineering & Science, Khanna Publishers New Delhi,2001.
2. M.K.JAIN,S.R.IYENGAR & R.K.JAIN Numerical Methods for Engineering & Computation, New Age, New Delhi,2001.
3. C.F.GERALD & P.O.WHEATLEY Applied Numerical Analysis, Addison Wesley, Singapore,2003.

BEEER42	DIGITAL ELECTRONICS AND HDL PROGRAMMING	3	1	0	4

UNIT - I NUMBER SYSTEM & BOOLEAN ALGEBRA **9 hours**

Review of binary, octal, hexadecimal number-conversions- signed binary arithmetic (2's complement method)- BCD Arithmetic-Deriving a Boolean equation from truth table-simplification of Boolean functions using K-maps & Quine McCluskey method.

UNIT –II COMBINATIONAL CIRCUITS **9 hours**

Truth table and Boolean equation for fundamental and derived gates-AND, OR,NOT,NOR,NAND,EX-OR gates-Implementation of a Boolean function using Logic gates and universal gates-Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers- Function realization multiplexers. Memories: ROM, PROM, EPROM, PLA, PLD, FPGA

UNIT – III SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS

9 hours

Latches-Flip flops - Analysis of synchronous sequential circuits- state diagram; state reduction; state assignment-Mealy and Moore Models- Design of Shift Registers and counters (Binary and BCD). Analysis and Design Procedure for Asynchronous Sequential Logic-Reduction of state and Flow tables, Race-Free state assignment.

UNIT - IV HARDWARE DESCRIPTION LANGUAGE-COMBINATIONAL CIRCUITS

9 hours

Introduction to Verilog HDL-module representation-Description of simple circuit-circuit with gate delays-stimulus for simple circuit-circuit specified with Boolean expression-user defined primitives-gate level modeling,data flow modeling,Behavioral modeling-writing a simple test bench.

UNIT – V HARDWARE DESCRIPTION LANGUAGE-SEQUENTIAL CIRCUITS

9 Hours

Flipflops and latches description-mealy state digram in verilog-HDL for registers and counters-RTL in HDL-HDL operators-continuous ssignment,procedural assignment,blocking and non blocking statements-RTL description of binary multiplier and testing of binary multiplier.

Text Books: **Tutorial = 15**

Total no. of Hours = 60

1. M. Morris Mano, 'Digital Logic and Computer Design', Prentice Hall of India, 2002.
2. John M.Yarbrough, 'Digital Logic, Application & Design', Thomson, 2002.

Reference Books:

1. Charles H.Roth, 'Fundamentals Logic Design', Jaico Publishing, IV edition, 2002.
2. Floyd, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.
3. John F.Wakerly, 'Digital Design Principles and Practice', 3rd edition, Pearson Education, 2002

BEEER43	ELECTRICAL MEASUREMENTS & INSTRUMENTATION	3	0	0	3

UNIT-I INTRODUCTION 6-Hour

Functional elements of an Instrument -Static and Dynamic characteristics -Errors in measurement Statistical evaluation of measurement data -Standard and Calibration.

UNIT-II ELECTRICAL AND ELECTRONICS INSTRUMENTS 12-Hours

Principle and types analog and digital ammeters and voltmeters -Single and three phase Wattmeter and Energy meter - magnetic measurements -Instrument Transformers -Instruments for measurement of frequency and phase.

UNIT-III SIGNAL CONDITIONING CIRCUITS 9-Hours

Bridge circuits – Differential and Instrumentation amplifiers -Filter circuits - V/f and f/V converters – P/I and I/P converters – S/H Circuit, A/D and D/A converters -Multiplexing and De-multiplexing -Data acquisition systems –Grounding techniques.

UNIT-IV STORAGE AND DISPLAY DEVICES 8-Hours

Magnetic disc and Tape Recorders -Digital plotters and printers -CRT displays -Digital CRO – LED, LCD and Dot matrix displays.

UNIT-V TRANSDUCERS 10-Hours

Classification of Transducers -Selection of Transducers – Resistive, Capacitive and Inductive Transducers - Piezo electric Transducers -Optical and Digital Transducers -PH electrodes - Transducers for measurement of displacement, temperature, level, flows, pressure, velocity, acceleration, torque, speed, viscosity and moisture.

Total no. of Hours = 45

TEXT BOOKS:

1. Doebeling,E.O., “Measurement Systems – Application and Design”, McGraw Hill Publishing Company, 1990.
2. H.S. Kalsi, “Electornic Instrumentation”, TMH Co., 1995.

REFERENCES:

1. Stout M.B., “Basic Electrical Measurement”, Prentice Hall of India, 1986.
2. Dalley, J.W., Riley, W.F. and Meconnel, K.G., “Instrumentation for Engineering Measurement”, John Wiley & Sons, 1993
   Moorthy, D.V.S., “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., 1995.

BEEER44	NETWORKS AND SYSTEMS	3	1	0	4

UNIT-I TRANSIENT ANALYSIS 9-Hours

Transient concepts-Behaviour of circuit elements under switching conditions and their representation- Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations using laplace transform methord – natural frequency and damping factor.

UNIT-II TWO PORT NETWORKS 9-Hours

Characterization of two port networks in terms of Z, Y, H and T parameters – networks equivalents – relations between network parameters – Analysis of T, Ladder, Bridged–T and lattice networks – transfer function of terminated two port networks.

UNIT-III S-DOMAIN ANALYSIS & NETWORK SYNTHESIS 9-Hours

S - domain network – driving point and transfer impedances and their properties – transform network analysis – Concept of complex frequency - poles and zeros of network functions – time domain response from pole-zero plot.Realizability of one port network – Hurwitz polynomials and properties – Positive Real functions and properties – synthesis of RL, RC and LC one port networks.

UNIT-IV FILTERS & ATTENUATORS 9-Hours

Classification of Filters - filter networks - design of constant K, m–derived and composite filters. Analysis of T, π, lattice, bridged-T, and L type attenuators.

UNIT-V SYSTEMS AND THEIR REPRESENTATION 9-Hours

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

Tutorial = 15

Total no. of Hours = 60

TEXTBOOKS:

1. Sudhakar. A., and Shyammohan, “Circuits and Networks Analysis and Synthesis” Tata McGraw Hill Publishing Co.Ltd. New Delhi, 1994.
2. Kuo F.F., “Network Analysis and Synthesis”, Wiley International Edition, Second Edition, 1966.

REFERENCES BOOKS:

1. Van Valkenburg, M.E., “Network Analysis”, Prentice – Hall of India Private Ltd., New Delhi, Third Edition, 1974.
2. Roy Choudhury, “Networks and Systems”, New Age International Ltd, 1992.

BEEER45	ELECTRICAL MACHINES - II	3	1	0	4

UNIT-I SYNCHRONOUS GENERATORS 9-Hours

Types & Constructional Features of Synchronous Generators– EMF Equation – emf equation – Armature reaction Synchronous reactance- Voltage regulation – e.m.f, m.m.f, z.p.f and A.S.A methods – Synchronizing and parallel operation – Synchronizing torque - Change of excitation and mechanical input –Salient pole synchronous machine- Two reaction theory –- Determination of direct and quadrature axis synchronous reactance using slip test.

UNIT – II SYNCHRONOUS MOTORS 9 Hours

Principle of operation – Construction – Equivalent Circuit and phasor diagram – Power and Torque – Speed-Torque characteristics – Effect of change in excitation - V curves and inverted V curves – Hunting & suppression – Starting methods – Synchronous Condenser.

UNIT-III THREE PHASE INDUCTION MACHINES 9-Hours

Construction – types – Principle of operation – Equivalent circuit – Torque and Power output – Torque-slip characteristics – Testing - Circle diagram – Starting - Cogging and Crawling - Speed control - Deep bar rotor - Double cage rotor – Induction generator.

UNIT-IV STARTING & SPEED CONTROL OF INDUCTION MACHINES 9-Hours

Starting methods of three phase induction motor – Cogging & Crawling – Speed control – Voltage control –Rotor resistance control – Pole changing – Frequency control – Slip – energy recovery scheme.

UNIT-V FRACTIONAL HORSEPOWER MOTORS 9-Hours

Single phase induction motor – Double revolving field theory – equivalent circuit – Speed-torque characteristics – starting methods – Split-phase motor - shaded-pole induction motor – Universal motor – Repulsion motor – Reluctance motor – Hysteresis motor – Stepper motor – Two-phase servo motor - AC tachometer - Linear induction motor.

Tutorial = 15

Total no. of Hours = 60

TEXT BOOK:

1.Nagrath,I.J. and Kothari.D.P., "Electric Machines", T.M.H publishing Co Ltd., New Delhi, Seventh Edition, 2005.

2 .P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

REFERENCE BOOKS:

1. Fitzgerald Kingsley and Umans, *Electric Machinery* 5th Edition, McGraw Hill Books co., New Delhi, 1990.

2. Stephen J. Chapman, *Electric Machinery Fundamentals*, McGraw Hill Book Co., New Delhi 1985.

3. Say.M.G., *Alternating current Machines*, ELBS & Pitman London, IV edition 1980.

4. Sen.S.K., *Electrical Machinery*, Khanna Publishers, New Delhi, 1984.

BEEER46	ELECTROMAGNETIC FIELD THEORY	3	1	0	4

UNIT-I INTRODUCTION 9-Hours

Sources and effects of electromagnetic fields – Vector fields – co-ordinateSystems-Rectangular, cylindrical, & spherical coordinate systems–Expressions for Grad, div, curl in cylindrical & spherical coordinates.

UNIT – II ELECTROSTATICS 9 Hours

The field concept – sources of electromagnetic fields, Changes – Columb's Law – Electric field intensity – Electric flux – Gauss's law – Potential – Boundary value problems – Laplace and Poisson's equations – Electrostatic energy – dielectrics – capacitance.

UNIT-III MAGNETOSTATICS 9-Hours

Lorentz Law of force, magnetic field intensity – Biot–savart Law - Ampere's Law –Magnetic field due to straight conductors, circular loop, infinite sheet of current –Magnetic flux density (B) – B in free space, conductor, magnetic materials –Magnetization – Magnetic field in multiple media – Boundary conditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density – Magneticcircuits.

UNIT-IV ELECROMAGNETIC FIELDS 9-Hours

Faraday's laws, induced emf – Transformer and motional EMF – Forces and Energy inquasi-stationary Electromagnetic Fields - Maxwell's equations (differential and integralforms) – Displacement current – Relation between field theory and circuit theory.

UNIT-V ELECTROMAGNETIC WAVES 9-Hours

Generation – Electro Magnetic Wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, loss and lossless dielectrics,conductors-skin depth, Poynting vector – Plane wave reflection and refraction – Transmission lines – Line equations – Input impedances – Standing wave ratio and power.

Tutorial = 15

Total no. of Hours = 60

TEXT BOOKS:

1. Mathew N. O. SADIKU, 'Elements of Electromagnetics', Oxford University pressInc. First India edition, 2007.

2. "Engineering Electromagnetics"by William H. Hayt & John A.Buck Mc-Graw-Hill 7th Edition 2005.

REFERENCES:

1.John D Kraus, "Electromagnetics", McGraw Hill Book Co., New York, Third Edition, 1989.

2. Joseph A Edminister, "Theory and Problems of Electro Magnetics", Schaums outline series McGraw Hill book company New York, 1986.
3. David J Griffith, "Introduction to Electrodynamics", Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 1997.

4.Richard E. Dubroff, S.V.Marshall, G.G.Skitek, "Electromagnetic Concepts and Applications", Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 1996.

BEEERP41	DIGITAL DESIGN LAB	0	0	3	1

1. Study of Logic Gates & Digital Logic families
2. Implementation of Boolean functions
3. Adders & Subtractors
4. Multiplexers and de-multiplexers
5. Study of Flip-flops
6. Study of Registers
7. Study of Counters
8. Implementation of any general combinational / sequential logic circuits
9. Design and testing of following circuits using Verilog HDL
    (a) Half Adder & Full Adder
    (b) Half Subtractor & Full Subtractor
    (c) Multiplexers and de-multiplexers
    (d) Counters
    (e) Magnitude Comparators
    (f) Registers

Total no. of Hours = 45

BEEERP42	ELECTRICAL MACHINES LAB – II	0	0	3	1

1. Regulation of 3-phase alternator by EMF and MMF methods.
2. Regulation of 3-phase alternator by ZPF and ASA method.
3. Regulation of Salient pole alternator - Slip Test.
4. Load Test on Alternator.
5. Synchronizing and Parallel operation of alternators.
6. V and inverted V curve of synchronous motors.
7. Load test on three-phase induction motor.
8. No load and blocked rotor test on three-phase induction motor.
9. Load Test on single-phase induction motor.
10. Speed control of three-phase induction motor.
11. Separation of losses in three-phase induction motor.
12. Equivalent circuit and pre-determination of performance characteristics of Single-phase induction motor.

Total no. of Hours = 45

BEEER51	OBJECT ORIENTED PROGRAMMING	3	0	0	3

UNIT-I INTRODUCTION 9-Hours

Programming methodologies – Comparison - Object Oriented concepts - Basics of C++ environment.

UNIT-II CLASSES 9-Hours

Definition - Data members - Function members - Access specifiers - Constructors - Default constructors - Copy constructors – Destructors - Static members-This pointer-Constant members - Free store operators -Control statements

UNIT-III INHERITANCE AND POLYMORPHISM 9-Hours

Overloading operators – Functions – Friends - Class derivation -Virtual functions - Abstract base classes - Multiple inheritance - Microsoft Foundation Class Libraries

UNIT-IV TEMPLATES 9-Hours

Class templates-Function templates-Exception handling-Streams.

UNIT-V JAVA PROGRAMMING 9-Hours

Java environment – Classes – Definition – Fields – Methods - Object creation – Constructors - Overloading methods - Static members - This keyword - Nested classes - Extending classes-Inheritance - member accessibility - Overriding methods-Abstract classes-Interfaces.

Total no. of Hours = 45

TEXT BOOKS

1. B. Trivedi, “Programming with ANSI C++”, Oxford University Press, 2007.
2. Cay S. Horstmann, Gary Cornell, “Core JAVA volume 1”, Eighth Edition, Pearson Education, 2008.

REFERENCES:

1. ISRD Group, “Introduction to Object-oriented Programming and C++”, Tata McGraw-Hill Publishing Company Ltd., 2007.
2. ISRD Group, “Introduction to Object-oriented programming through Java”, Tata McGraw-Hill Publishing Company Ltd., 2007.
3. S. B. Lippman, Josee Lajoie, Barbara E. Moo, “C++ Premier”, Fourth Edition, Pearson Education, 2005.
4. D. S. Malik, “C++ Programming: From Problem Analysis to Program Design”, Third Edition, Thomson Course Technology, 2007.
5. K. Arnold and J. Gosling, “The JAVA programming language”, Third edition, Pearson Education, 2000.
6. C. Thomas Wu, “An introduction to Object-oriented programming with Java”, Fourth Edition, Tata McGraw-Hill Publishing Company Ltd., 2006.

BEEER52	LINEAR & DIGITAL INTEGRATED CIRCUITS	3	0	0	3

UNIT – I OPERATIONAL AMPLIFIERS 9-Hours

Ideal OP-AMP characteristic-Inverting and non-inverting amplifiers-Analysis of typical opamp-equivalent circuit-open loop gain-CMMR-Input referred errors-Compensation techniques-DC-AC amplifiers-frequency response characteristics Noise-stability-limitation-frequency compensation-slew rate.; Basic applications of op-amp – summer, differentiator and integrator.

UNIT – II APPLICATIONS OF OPAMP 9-Hours

Basic applications of opamp—summer,differentiator,integrator precision rectifier Instrumentation amplifier-- first and second order active filters-- V/I & I/V converters—comparators—multivibrators-- waveform generators—clippers- clampers- peak detector--S/H circuit--D/A converter (R-2R ladder and weighted resistor types)-- A/D converter - Dual slope, successive approximation and flash types.

UNIT –III OTHER LINEAR ICs 9-Hours

Voltage regulators—IC723—current limiting and current boosting-fixed and adjustable three terminal regulators-SMPS--IC555 Timer circuit – Functional block, characteristics & applications-IC 566-voltage controlled oscillator circuit--IC565-phase lock loop circuit functioning and applications-- Analog multiplier ICs.

UNIT – IV COMBINATIONAL LOGIC CIRCUITS 9-Hours

Logic gates –logic families—TTL,ECL,MOS and CMOS Logic families-comparison of performances-Speed,fan-in,fan-out,propagation delay,power dissipation,noise margin—designing combinational logic circuits using logic gates—adders-subtractors-BCD adders/subtractors—decoders-encoders-multiplexers-demultiplexers-magnitude comparators—code converters—odd/even parity generators and checkers-design of combinational logic circuits using multiplexers and decoders

UNIT - V SEQUENTIAL CIRCUIT DESIGN 9-Hours

Flip-flops-Ripple counters-Shift registers-Ring counters-Johnson's counter-Frequency counter-Digital clock—Synchronous counter-State table—state diagram-state reduction-state assignment—Design of synchronous and asynchronous sequential circuits

Total no. of Hours = 45

TEXT BOOKS:

1. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI.
2. D.Roy Choudhary, Sheil B.Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.

REFERENCE BOOKS

1. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2003.
2. Robert F.Coughlin, Fredrick F.Driscoll, 'Op-amp and Linear ICs', Pearson Education, 4th edition, 2002 / PHI.
3. David A.Bell, 'Op-amp & Linear ICs', Prentice Hall of India, 2nd edition, 1997.

BEEER53	CONTROL SYSTEMS	3	1	0	4

UNIT – I TIME RESPONSE 9-Hours

Standard test Signals-time domain study of first order and second order feedback control systems- Time domain specifications - I and II order system response - Error coefficients - Generalized error series - Steady state error - P, PI, PID controllers.

UNIT – II FREQUENCY RESPONSE 9-Hours

Frequency response - Bode plot - Polar plot - Constant M an N circles - Nichols chart - Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT – III STABILITY OF CONTROL SYSTEM 9-Hours

Characteristics equation - Location of roots in S plane for stability - Routh Hurwitz criterion - Root locus construction - Effect of pole, zero addition - Gain margin and phase margin - Nyquist stability criterion.

UNIT – IV COMPENSATOR DESIGN 9-Hours

Performance criteria - Lag, lead and lag-lead networks - Compensator design using Bode plots.

UNIT – V STATE SPACE ANALYSIS 9-Hours

State space analysis - State space formulation -State variables - Phase variables and Canonical variables – Derivation of transfer function from state model- State transition matrix-Solution of state equations by Laplace transform – concept of controllability & observabliity.

Tutorial = 15

Total no. of Hours = 60

Text Books:

1. K. Ogata, 'Modern Control Engineering', 4th edition, Pearson Education, New Delhi, 2003 / PHI.
2. I.J. Nagrath & M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.

Reference Books:

1. B.C. Kuo, 'Automatic Control Systems', Prentice Hall of India Ltd., New Delhi, 1995.
2. M. Gopal, 'Control Systems, Principles & Design', Tata McGraw Hill, New Delhi, 2002.
3. M.N. Bandyopadhyay, 'Control Engineering Theory and Practice', Prentice Hall of India, 2003.

BEEER54	TRANSMISSION & DISTRIBUTION	3	1	0	4

UNIT – I INTRODUCTION 9 –Hour

Structure of electric power system - different operating voltages of generation, transmission and distribution – advantage of higher operating voltage for AC transmission. An introduction to EHV AC transmission, HVDC transmission and FACTS.

Mechanical design of transmission line between towers – sag and tension calculationsusing approximate equations taking into account the effect of ice and wind.

UNIT – II TRANSMISSION LINE PARAMETERS 9-Hour

Parameters of resistance, inductance and capacitance calculations - single and three phase transmission lines - single and double circuits - solid, stranded and bundled conductors symmetrical and unsymmetrical spacing – transposition of lines - concepts of GMR and GMD - skin and proximity effects - interference with neighbouring communicationcircuits.

UNIT – III MODELLING AND PERFORMANCE OF TRANSMISSION LINES 9-Hour

Regulation and efficiency- short line-, medium line represented by nominal T and Pi methods-long lines-rigrous solution-ABCD constants – Ferranti effect and Corona loss - surge impedance, attenuation constant and phase constant – power circle diagrams – shunt and series compensation.

UNIT – IV INSULATORS AND CABLES 9-Hours

Classification of insulators for transmission and distribution purpose – voltage distribution in insulator string and grading - improvement of string efficiency. Underground cables - constructional features of LT and HT cables – insulation resistance, capacitance, dielectric stress and grading – tan δ and power loss - thermal characteristics**.**

UNIT – V DISTRIBUTION SYSTEM AND SUBSTATIONS 9- Hours

Feeders, distributors and service mains – DC distributor – 2-wire and 3-wire, radial and ring main distribution. AC distribution – single phase and three phase 4-wire distribution. Classification, functions and major components of substations-sample substation layout.

Tutorial = 15

Total no. of Hours = 60

TEXT BOOKS

1. B.R.Gupta, 'Power System Analysis and Design', S. Chand, New Delhi, 2003.
2. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, 2002.

REFERENCES

1. Luces M. Fualkenberry, Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 1996.
2. Hadi Saadat, 'Power System Analysis,' Tata McGraw Hill Publishing Company', 2003.
3. Central Electricity Authority (CEA), 'Guidelines for Transmission System Planning', New Delhi.

BEEER55	DESIGN OF ELECTRICAL MACHINES*	3	1	0	4

UNIT-I INTRODUCTION 9-Hours

Major considerations – Limitations – Electrical Engineering Materials – Space factor temperature gradient – Heat flow in two dimensions – Thermal resistivity of winding – Temperature gradient in conductors placed in slots – Rating of machines – Eddy current losses in conductors – Standard specifications

UNIT-II DC MACHINES 9-Hours

Magnetic circuit calculations –Net length of Iron –Real & Apparent flux densities – Design of rotating machines – D.C machines output equations – Selection of number of poles – Design of shunt and series field windings - Armature design – Design of Commutator and brushes.

UNIT-III TRANSFORMERS 9-Hours

KVA output for single and three phase transformers – Window space factor – Overall dimensions – Operating characteristics – Regulation – No load current – Temperature rise of Transformers – Design of Tank with & without cooling tubes – Thermal rating – Methods of cooling of Transformers.

UNIT-IV INDUCTION MOTORS 9-Hours

Magnetic leakage calculations – Leakage reactance of poly-phase machines- Magnetizing current – Output equation of Induction motor – Main dimensions –Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor - Operating characteristics –Short circuit current – circle diagram – Dispersion co-efficient – relation between D & L for best power factor.

UNIT-V SYNCHRONOUS MACHINES 9-Hours

Runaway speed – construction – output equations – choice of loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design - Introduction to computer aided design – Program to design main dimensions of Alternators.

Tutorials = 15

Total no. of Hours = 60

TEXT BOOK:

Sawhney, A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 1984.

REFERENCES:

Sen, S.K., "Principles of Electrical Machine Designs with Computer Programmes", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987.

*** The end semester examination will be conducted as Practical Examination with External and Internal Examiners.**

BEEER56	COMMUNICATION ENGINEERING	3	0	0	3

UNIT – I ANALOG COMMUNICATION **9-Hours**

AM – Frequency spectrum – vector representation – power relations – generation of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – frequency spectrum – power relations : NBFM & WBFM, Generation of FM and DM, Amstrong method & Reactance modulations : FM & PM frequency.

UNIT – II DIGITAL COMMUNICATION **9-Hours**

Pulse modulations – concepts of sampling and sampling theormes, PAM, PWM, PPM, PTM, quantization and coding : DCM, DM, slope overload error. ADM, DPCM, OOK systems – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, applications of Data communication.

UNIT – III SOURCE CODES, LINE CODES & ERROR CONTROL (Qualitative only) **9-Hours**

Primary communication – entropy, properties, BSC, BEC, source coding : Shaum, Fao, Huffman coding : noiseless coding theorum, BW – SNR trade off codes: NRZ, RZ, AMI, HDBP, ABQ, MBnB codes : Efficiency of transmissions, error control codes and applications: convolutions & block codes.

UNIT- IV MULTIPLE ACCESS TECHNIQUES **9-Hours**

SS&MA techniques : FDMA, TDMA, CDMA, SDMA application in wire and wireless communication : Advantages (merits) :

UNIT – V SATELLITE, OPTICAL FIBER – POWERLINE, SCADA **9-Hours**

Orbits : types of satellites : frequency used link establishment, MA techniques used in satellite communication, earth station; aperture actuators used in satellite – Intelsat and Insat: fibers – types: sources, detectors used, digital filters, optical link: power line carrier communications: SCADA

TEXT BOOKS **Total no. of Hours = 45**

1.Taub & Schiling “Principles of communication systems” Tata McGraw hill 2007
2.J.Das “Principles of digital communication” New Age International, 1986

REFERENCES

1. Kennedy and Davis “Electronic communication systems” Tata McGraw hill, 4th edition, 1993.
2. Sklar “Digital communication fundamentals and applications“ Pearson Education, 2001
3. Bary le, Memuschmidt, digital Communication, Kluwer Publication, 2004.
4. B.P.Lathi “Modern digital and analog communication systems” Oxford University Press, 1998.

BEEERP51	LINEAR & DIGITAL INTEGRATED CIRCUITS LAB	0	0	3	1

1. Series and Shunt Voltage Regulators
2. Characteristics of BJT, JFET
3. RC and Wein bridge oscillators.
4. Schmitt trigger.
5. Multi vibrators, Mono stable, Astable, Bitable.
6. RC Coupled amplifier (with and without feedback).
7. Measurement of Op-Amp Characteristics.
8. Op-amp applications I – Inverting & Non-inverting amplifier, summer, Multiplier, logarithmic and differential amplifiers, Integrator.
9. Op-amp applications –II –Wave form generation, Multi-vibrators
10. Study of 555 IC and its applications
11. Voltage controlled oscillator.
12. A/D & D/A converters

Total no. of Hours = 45

BEEERP52	CONTROL & INSTRUMENTATION LAB	0	0	3	1

1. Transfer function of self excited DC Generator
2. Transfer function of Armature controlled DC Motor.
3. Transfer function of Field controlled DC Motor.
4. Transfer function of AC Servomotor.
5. Frequency response of Lag, Lead & Lag – Lead networks.
6. Study of DC Position Control system.
7. Study of P, PI and PID Controllers (First Order).
8. Study of temperature measuring transducers (Thermocouples).
9. Study of displacement and pressure transducers (LVDT).
10. AC Bridges.
11. DC Bridges.
12. Calibration of Single phase Energy meter.
13. Calibration of Three-phase Energy meter.
14. Measurement of Three-phase power and power factor.

Total no. of Hours = 45

BEEER61	PRINCIPLES OF MANAGEMENT	3	0	0	3

UNIT-I MANAGEMENT THEORY AND SCIENCE **9-Hours**

Definition of Management – Science, Theories of Management – Managing : Science or Art? – Management & Society: Social Responsibility – Ethics ad Value Systems.

UNIT-II PLANNING **9-Hours**

Definition – The Nature and Purpose of Planning – Types of planning – Steps in Planning – The Planning process – Objecives - Strategies, Policies and Planning Premises- Forecasting – Decision-making.

UNIT-III ORGANIZING **9-Hours**

Definition – The nature and Purpose of organization – Organization levels and the span of Management – Departmentation – Line/Staff Authority – Centralization – Decentralization – Effective organization & Organizational culture – Staffing – Managerial Job – An overview of staffing function (selection process, techniques and instruments) – Performance appraisal and career strategy – Management Development process and training – Managing change – Organizational development.

UNIT-IV LEADING **9-Hours**

Human factors in Managing – Behavioral models – Creativity and innovation – Motivational theories – Special motivational techniques – Job enrichment – Leadership Behaviors & styles – Situational or contingency approaches to leadership. Communication – Communication process – Barriers and breakdowns in communication – Towards Effective communication.

UNIT-V CONTROLLING **9-Hours**

The system and process of Controlling – Control Technique – Information Technology – Productivity & Operation Management – Overall Preventing Control – International Management – Toward a unified, Global Management Theory.

Total no. of Hours = 45

TEXT BOOKS

1. Kooniz, "Essentials of Management", Tata Mcgraw Hill,2001.
2. Stephen P.Robbins and David A.Decenzo,Fundamentals of Management, Pearson Educaion, Third Edition, 2001.

REFERENCES

1. J.S.Chandan, Managemen Concepts and Strategies, Vikas Publishing House, 2002.
2. Tim Hannagan, Management Concepts and Practices, Macmillan India Ltd. 1997.
3. Hellriegel, Jackson and Slocum, Management: A competency – Based Approach Souh Western, 9th Edition 2002.
4. Stewart Black and Lyman W.Porter, Management –Meeting New Challenges, Prentice Hall, 2000.

BEEER62	MICROPROCESSOR AND MICROCONTROLLER	3	0	0	3

UNIT – I 8085 PROCESSOR & PROGRAMMING 9-Hours

Functional block diagram - Signals - Memory interfacing - I/O ports and data transfer concepts - Timing Diagram Interrupt structure. Instruction format and addressing modes - Assembly language format - Data transfer, data manipulation &control instructions - Programming: Loop structure with counting & Indexing -Lookuptable-Subroutineinstructions stack.

UNIT – II 16 - BIT MICROPROCESSORS AND PROGRAMMING 9-Hours

Architecture of Intel 8086 - instruction set and addressing modes - minimum and maximum mode. CPU module design - memory I/O - pipelining and RISC principle.

UNIT – III PERIPHERAL INTERFACING 9-Hours

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART,8279Keyboarddisplay controller and 8253 Timer/ Counter - Interfacing with8085-A/DandD/A converter interfacing and applications - DC.

UNIT – IV MICRO CONTROLLER 8051 9-Hours

Functional block diagram - Instruction format and addressing modes - Interrupt structure - Timer -I/O ports Serial communication.

UNIT – V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9-Hours

Data Transfer, Manipulation, Control & I/O instructions - Simple programming exercises key board and display interface - Closed loop control of servo motor- stepper motor control.

Total no. of Hours = 45

Text Books:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', Wiley Eastern Ltd., New Delhi, 1995.
2. M. Raffiquzaman, 'Microprocessor and Microcomputer Based System Design'.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, 'The 8051 Micro Controller and Embedded Systems', Pearson Education, 5th Indian reprint, 2003.

Reference Books:

1. William Kleitz, 'Microprocessor and Micro Controller Fundamental of 8085 and 8051 Hardware and Software', Pearson Education, 1998.

BEEER63	POWER SYSTEM ANALYSIS	3	1	0	4

UNIT – I INTRODUCTION **9-Hours**

Modern power system (or) electric energy system - Analysis for system planning and operational studies – basic components of a power system. Generator models - transformer model – transmission system model - load representation. Single line diagram – per phase and per unit representation – change of base. Simple building algorithms for the formation of Y-Bus matrix and Z-Bus matrix.

UNIT – II POWER FLOW ANALYSIS **9-Hours**

Importance of power flow analysis in planning and operation of power systems. Problem definition – Bus classification –Derivation of power flow equation –Solution by Gauss–Seidel, Newton-Raphson methods and FDLF – Modifications when P-V buses are present - Computation of slack bus power, transmission loss and line flows.

UNIT – III FAULT ANALYSIS – BALANCED FAULTS **9-Hours**

Importance short circuit (or) for fault analysis - basic assumptions in fault analysis of power systems.Symmetrical (or) balanced three phase faults – problem formulation – fault analysis using Z-bus matrix – algorithm and flow chart. Computations of short circuit capacity, post fault voltage and currents.

UNIT – IV FAULT ANALYSIS – UNBALANCED FAULTS **9-Hours**

Introduction to symmetrical components – sequence impedances – sequence networks – representation of single line to ground, line to line and double line to ground fault conditions. Unbalanced fault analysis - problem formulation – analysis using Z-bus impedance matrix – (algorithm and flow chart.).

UNIT – V STABILITY ANALYSIS **9-Hours**

Importance of stability analysis in power system planning and operation - classification of power system stability - angle and voltage stability – simple treatment of angle stability into small-signal and large-signal (transient) stability-Single Machine Infinite Bus (SMIB) system: Development of swing equation-solution by modified Euler method and fourth order RK method - equal area criterion - determination of critical clearing angle-Methods of improving transient stability.

Tutorials = 15 **Total no. of Hours = 60**

TEXT BOOKS

1. Hadi Saadat, ‘Power System Analysis’, Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Olle. I. Elgerd, ‘Electric Energy Systems Theory – An Introduction’, Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2003.

REFERENCES

1. P. Kundur, ‘Power System Stability and Control, Tata McGraw Hill, Publications, 1994.2.
2. John J. Grainger and W.D. Stevenson Jr., ‘Power System Analysis’, McGraw Hill International Book Company, 1994.

3. I.J. Nagrath and D.P. Kothari, ‘Modern Power System Analysis’, Tata McGraw-Hill Publishing Company, New Delhi, 1990.

BEEER64	POWER ELECTRONICS	3	1	0	4

UNIT-I POWER ELECTRONIC DEVICES 9-Hours

Characteristics of power devices – characteristics of SCR – two transistor model of SCR,Characteristics of TRIAC, BJT, MOSFET, IGBT, GTO both static and switching characteristics – Protection of thyristors against over voltage – over current, dv/dt and di/dt.

UNIT-II TRIGGERING & COMMUTATION TECHNIQUES 9-Hours

Turn on circuits for SCR – Triggering with single pulse & train of pulses – triggering with microprocessor – different techniques of commutation – natural and forced commutation – series & parallel operations..

UNIT-III PHASE CONTROLLED CONVERTERS 9-Hours

Converters – single phase – three phase – half controlled and fully controlled rectifiers with R, RL and RLE loads – Waveforms of load voltage and line current – harmonic factor, power factor, ripple factor, distortion factor – operation with freewheeling diode – effect of source inductance – dual converter**.**

UNIT-IV INVERTERS & CHOPPERS 9-Hours

Voltage and current source inverters, resonant, series inverter – basic series inverter, modified, improved – PWM techniques – single phase AC choppers with R and RL load – half wave and full wave – DC choppers – Various classes of Operation – Buck, boost and buck – boost type choppers – merits and applications.

UNIT-V AC VOLTAGE CONTROLLERS & INDUSTRAIL APPLICATIONS 9-Hours

Single-phase and three-phase AC voltage controllers - Sequence control of AC voltage regulators. Cycloconverters – single-phase and three-phase cycloconverters, SMPS & UPS – Static ompensators – HVDC Transmission system.

Tutorials = 15

Total no. of Hours = 60

TEXT BOOK:

Rashid, M.H., "Power Electronics - Circuits Devices and Applications", Prentice Hall of India, 3rd Edition, 2004.

REFERENCES:

1. Singh.M.D and Kanchandani, "Power Electronics", Tata McGraw Hill & Hill publication Company Ltd, New Delhi, 2002.
2. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., "Thyristorised Power Controllers", Wiley Eastern Limited, 1986.
3. Lander,W., "Power Electronics", McGraw Hill and Company, Third Edition, 1993.
4. P.S. Bimbhra, "Power Electronics", Khanna Publishers, 3rd Edition, 1999.

BEEER65	INTROUDCTION TO DIGITAL SIGNAL PROCESSING	3	1	0	4

UNIT – I SIGNALS AND SYSTEMS **9-Hours**

Signal classification-Signal Representation-Classification of Discrete time signals-typical discrete time signals-operation on signals-Discrete time system-classification of Discrete time systems-solution of difference Equations

UNIT –II Z TRANSFORM & REALIZATIONS **9-Hours**

Z Transform-Properties-System function-Inverse Z transform-Realization of Digital filters-Direct Form-I, Direct Form-II, Transposed, parallel, cascade, lattice-Ladder structure.

UNIT – III DFT &FFT **9-Hours**

Discrete Fourier Transform (DFT)-Definition-Properties-Convolution of Sequences-Linear convolution-circular convolution. Introduction to radix-2-FFT-Properties-DIT (FFT)-Algorithms of Radix-2 FFT-Computing Inverse DFT by doing a direct DFT.

UNIT – IV DESIGN OF DIGITAL FILTER **9-Hours**

Review of design techniques for analog low pass filters-Frequency transformation-Properties of IIR filter design-Characteristics of FIR filters with linear phase-Fourier series method-frequency sampling method-Design of FIR filters using windows.

UNIT – V APPLICATIONS OF DSP **9-Hours**

Multirate signal processing-sub band coding of speech signals-MATLAB Tool box for DSP

Tutorials = 15

Total no. of Hours = 60

TEXT BOOK:

Sanjit K. Mitra, "Digital Signal Processing-A Computer Based Approach", Tata McGraw Hill, New Delhi, 1998.

REFERENCES:

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Algorithms and Applications", PHI of Ltd, New Delhi, 3rd Edition, 2000.
2. Johnny R. Johnson, "Introduction to Digital Signal Processing", 9th Printing, September 2001.

BEEER66	POWER SYSTEM PROTECTION & SWITCHGEAR	3	0	0	3

UNIT-I RELAYS 12-Hours

Need for protection – essential qualities of protective relays – Electromagnetic relays, Induction relays – Over current relays - Directional, Distance, Differential and negative sequence relays – Universal Torque Equation.

UNIT-II APPARATUS PROTECTION 8-Hours

Transformer, Generator, Motor, Bus bar and Transmission line protection – Feeder protection.

UNIT-III CIRCUIT BREAKERS 7-Hours

Arc phenomena – arc interruption – Current zero interruption theories – recovery voltage and restriking voltage - RRRV – current chopping – Resistance switching- Various types of circuit breakers – selection and Testing of circuit breakers – Fuses – HRC fuses.

UNIT-IV PROTECTION AGAINST OVERVOLTAGES 9-Hours

Mechanism of lightning – Over voltage due to lightning – Protection against lightning – Protection of electrical apparatus against traveling waves – types of lightning arresters – Surge absorbers-grounding-Peterson Coil.

UNIT-V STATIC RELAYS 9-Hours

Static relays – components of static relays – over current relays, differential protection and distance protection - microprocessor-based relays.

Total no. of Hours = 45

TEXT BOOKS:

1. Ravindranath, B and Chander, N, "Power System Protection and Switchgear", Wiley Eastern Ltd., 1977
2. Chakrabarti.A, Soni.M.L, Gupta .P.V, Bhatnagar.U.S, "A Text Book on Power System Engineering", Dhanpat Rai & Co. Pvt. Ltd., 2002.

REFERENCES:

1. Patra, S.P., Basu, S.K. and Chowduri, S., "Power systems Protection", Oxford and IBH Publishing Co, 1983.
   Sunil.S.Rao, "Switchgear and Protection", Khanna Publishers, New Delhi, 1986.

BEEERP61	MICROPROCESSOR & MICROCONTROLLER LAB	0	0	3	1

8-bit Microprocessor-8085

1. Simple arithmetic operations:
   - Multi precision addition / subtraction / multiplication / division.
2. Programming with control instructions:
   - Increment / Decrement.
   - Ascending / Descending order.
   - Maximum / minimum of numbers.
   - Rotate instructions.
   - Hex / ASCII / BCD code conversions.
3. Interface Experiments:
   - A/D Interfacing.
   - D/A Interfacing.
   - Traffic light controller.
4. Interface Experiments:
   - Simple experiments using 8251, 8279, 8254.
5. Programming practice on assembler and simulator tools.

8-bit Micro controller-8051

6. Demonstration of basic instructions with 8051 Micro controller execution, including:
   - Conditional jumps, looping
   - Calling subroutines.
   - Stack parameter testing
7. Parallel port programming with 8051 using port 1 facility:
   - Stepper motor and D / A converter.
8. Programming Exercise on
   - RAM direct addressing
   - Bit addressing
9. Programming practice using simulation tools and C - compiler
   - Initialize timer
   - Enable interrupts.
10. Study of micro controllers with flash memory.

Total no. of Hours = 45

BEEERP62	POWER ELECTRONICS LAB	0	0	3	1

1. SCR, MOSFET & IGBT Characteristics
2. UJT, R, RC Firing circuits for SCR.
3. SCR DC Voltage Commutated chopper.
4. SCR DC Current Commutated chopper.
5. SCR phase control circuit.
6. TRIAC phase control circuit
7. SCR half controlled & fully controlled converters.
8. SCR three phases AC regulator.
9. Speed control of DC shunt motor using three- phase fully controlled converter.
10. SCR single-phase cyclo-converter.
11. SCR series inverter.
12. SCR Parallel inverter.
13. IGBT chopper.
14. IGBT Based PWM inverter (Single Phase).

Total no. of Hours = 45

BEEER71	BASICS OF EMBEDDED SYSTEMS DESIGN	3	0	0	3

UNIT - I INTRODUCTION TO EMBEDDED SYSTEMS 9-Hours

Components of embedded system hardware-Processors, memory devices, I/O devices, I/O ports, timer, Interrupt controllers-Software Embedded into a system.

UNIT – II PROCESSOR AND MEMORY ORGANIZATION 6-Hours

Structural units in a processor; selection of processor & memory devices; shared memory; DMA; interfacing processor, memory and I/O units; memory management – Cache mapping techniques, dynamic allocation - Fragmentation.

UNIT – III DEVICES & BUSES FOR DEVICES NETWORK 9-Hours

I/O devices; timer & counting devices; serial communication using I^2C, CAN, USB buses; parallel communication using ISA, PCI, PCI/X buses, arm bus; interfacing with devices/ports, device drivers in a system – Serial port & parallel port.

UNIT – IV MULTIPLE PROCESSING AND SCHEDULE MECHANISM 12-Hours

Multiple processes in an application-Concept of process, Task, Threads-Distinction between Functions, ISRS, Tasks- Shared data problem and solution-Critical section, Semaphores, Mutex, priority inversion problem and deadlock-Inter process communication-signals, Mutex, Message Queues, Mail box.

UNIT – V REAL TIME OPERATING SYSTEM (RTOS) 9-Hours

Real-Time and Embedded system OS-Interrupt Routines in RTOS Environment-RTOS task scheduling models, Interrupt Latency and response times of the tasks-Performance metric in scheduling models for periodic, sporadic and aperiodic tasks-Embedded Linux Internals.

Total no. of Hours = 45

TEXT BOOKS

1. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata McGraw Hill, 2003.
2. Daniel W. Lewis 'Fundamentals of Embedded Software', Prentice Hall of India, 2004.

REFERENCE BOOKS

1. David E. Simon, 'An Embedded Software Primer', Pearson Education, 2004.
2. Frank Vahid, 'Embedded System Design – A Unified Hardware & Software Introduction', John Wiley, 2002.
3. Sriram V. Iyer, Pankaj Gupte, 'Embedded Real Time Systems Programming', Tata McGraw Hill, 2004.
4. Steve Heath, 'Embedded System Design', II edition, Elsevier, 2003.

BEEER72	POWER SYSTEM OPERATION AND CONTROL	3	1	0	4

UNIT – I INTRODUCTION **9-Hours**

System load Characteristics–load curves and load-duration curve - load factor - diversity factor. An overview of power system operation and control and the role of computers in the implementation. (Qualitative treatment with block diagram). Need for Voltage regulation and frequency regulation in power system - Basic P-f and Q-v control loops - cross coupling between control loops.

UNIT – II REAL POWER - FREQUENCY CONTROL **9-Hours**

Fundamentals of Speed Governing mechanisms and modeling - Speed-Load characteristics-regulation of two Synchronous Machines in parallel - Control areas - LFC of single & Multi areas - Static & Dynamic Analysis of uncontrolled and controlled cases –Tie line with frequency bias control – Steady state instabilities.

UNIT – III REACTIVE POWER–VOLTAGE CONTROL **9-Hours**

Excitation system Modeling - Static & Dynamic Analysis - stability compensation - Effect of Generator loading – static shunt capacitor, Reactive VAR compensator, Synchronous condenser, tap changing Transformer - static VAR System Modeling - System Level Voltage control

UNIT – IV UNIT COMMITMENT AND ECONOMIC DISPATCH **9-Hours**

Need for Economic Dispatch-Characteristics curve for Steam and hydroelectric Units - Co-ordination Equation with Loss and without losses - Solution by Iteration method & Gradient method (no derivation of loss co-efficient) - Base point and Participation Factor- Constraints in Unit Commitment -Unit Commitment Solution methods-Priority List methods- Dynamic Programming solution.

UNIT – V COMPUTER CONTROL OF POWER SYSTEMS **9-Hours**

Need of computer control of power systems. Concept of energy control centre (or) load dispatch centre and the functions - system monitoring - data acquisition and control. System hardware configuration – SCADA and EMS functions. Network topology - state estimation - security analysis and control. Various operating states (Normal, alert, emergency, in-extremis and restorative). State transition diagram showing various state transitions and control strategies.

Tutorials = 15

Total no. of Hours = 60

TEXT BOOKS

1. Allen. J. Wood and Bruce F. Wollenberg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2003.
2. Chakrabarti & Halder, "Power System Analysis: Operation and Control", Prentice Hall of India, 2004 Edition.

REFERENCES

1. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003. (For Chapters 1, 2 & 3)
2. L.L. Grigsby, 'The Electric Power Engineering, Hand Book', CRC Press & IEEE Press, 2001.
3. Hadi Saadat, "Power System Analysis", (For the chapters 1, 2, 3 and 4)11th Reprint 2007.
4. P.Kundur, 'Power System Stability and Control' MC Craw Hill Publisher, USA, 1994.

BEEER73	ELECTRICAL DRIVES & CONTROL	3	0	0	3

UNIT-I INTRODUCTION 9-Hours

Definition, block diagram and types of Electric Drives – dynamics of electric drives – torque equations – speed torque characteristics of DC and AC motors – components of load torque – load equalization – steady state stability – heating and cooling curves – loading conditions and classes of duty – Selection of power rating for drive motors.

UNIT-II DC DRIVES 9-Hours

Speed control of DC series and shunt motors – concepts of constant torque and constant power control – concepts of Armature and field control, Ward Leonard control system – Speed control Using single phase controlled rectifiers – fully controlled – half controlled – speed control using 3 phase fully controlled rectifier – control using DC choppers – multi quadrant operation – electric braking – closed loop control of DC drives.

UNIT-III INDUCTION MOTOR DRIVES 9-Hours

Concepts of stator voltage control, variable frequency control and V/f control – AD voltage controller fed induction motor drive – VSI fed induction motor drives – operation with field weakening – CSI controlled induction motor drives – PWM drives – concepts of rotor resistance control – slip power recovery scheme – Static Kramer's drive – static scherbius drives – braking of induction motor.

UNIT-IV SYNCHRONOUS MOTOR DRIEVS 9-Hours

Speed control of synchronous motor – adjustable frequency operation of synchronous Motor drives – Speed control of synchronous motor – self control operation from voltage source and current source – brushless DC and AC motors – load commutated synchronous motor drives fed from current source inverter – Principles of vector control.

UNIT-V ENERGY CONSERVATION AND SPECIAL CLASS OF DRIVES 9-Hours

Need for energy conservation in electrical drives – improvement of power factor , improvement of quality supply – solar and battery powered drives – Drives used for traction – Control of fractional hp motors.

Total no. of Hours = 45

TEXT BOOK:

1. Dubey. G.K., "Power Semiconductor Controlled Drives", Prentice Hall International, 1989.

2. B. K.Bose, "Modern Power Electronics and AC Drives", Prentice Hall Onglewood cliffs, New Jersey, 2002.

REFERENCES:

1. Vedam Subrahmanyam, "Electric drives concepts and applications", TMH Pub. Co.Ltd. 1994.
2. Murphy, J.M.D and Turnbull.F.G. , "Thyristor control of AC Motors", Pergamon Press, 1988.
3. Sen. P.C., "Thyristor D.C. Drives", John Wiley and Sons, 1981.
4. N.K. De and P.K Sen.," Electric Drives", Prentice Hall India, 2001.

BEEER74	HIGH VOLTAGE ENGINEERING	3	0	0	3

UNIT – I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 6-Hours

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – protection against over voltages – Bewley's lattice diagram.

UNIT – II ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUID 10-Hours

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids – Breakdown mechanisms in solid and composite dielectrics.

UNIT –III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 10-Hours

Generation of High DC, AC, impulse voltages and currents. Tripping and control of impulse generators.

UNIT – IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 10-Hours

Measurement of High voltages and High currents – Digital techniques in high voltage measurement.

UNIT – V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9-Hours

High voltage testing of electrical power apparatus – Power frequency, impulse voltage and DC testing – International and Indian standards – Insulation Coordination.

Total no. of Hours = 45

TEXT BOOK

1. M. S. Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 3rd Edition, 2004.

REFERENCES

1. E. Kuffel and W. S. Zaengel, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford, London, 1986.
2. E. Kuffel and M. Abdullah, 'High Voltage Engineering', Pergamon Press, Oxford, 1970.
3. L. L. Alston, Oxford University Press, New Delhi, First Indian Edition, 2006.

BEEERP71	DIGITAL SIMULATION LAB	0	0	3	1

1. Computation of Parameters and Modeling of Transmission Lines

2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.

3. Load Flow Analysis - I : Solution of Load Flow And Related Problems Using Gauss-Seidel Method

4. Load Flow Analysis - II: Solution of Load Flow and Related Problems Using Newton-Raphson and Fast-Decoupled Methods

5. Fault Analysis

6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System

7. Power Electronic Circuits, design and simulation using Pspice

8. Simulation of Electrical drives using MATLAB, PSCAD

Total no. of Hours = 45

BEEER81	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3

UNIT – I **9-Hours**

Entrepreneur – traits and types, creating and starting the venture – sources of new ideas, Methods of generating ideas, product planning and development process, Establishing evaluation criteria.

UNIT – II **9-Hours**

Business plan – Marketing plan – marketing research for the new venture, marketing mix, steps in preparing marketing plan. Financial plan – Proforma of income statements, cash flow, balance sheet, Break even Analysis, Application of funds. Organizational plan – legal forms of Businees, Tax attributes, Role of Board of Directors, Advisors, Designing the organization. Risk assessment, Sources of finance-equity, financial institutions, and commercial banks.

UNIT – III **9-Hours**

Record keeping – Meaning, methods, types, Hiring – concept, procedure for hiring, Motivation – entrepreneurial theories of motivation, leadership – styles of leadership.

UNIT – IV **9-Hours**

Financial control – Managing cash flow, managing inventory, fixed Assets, Managing cost and profits, Taxes. Entrpreneurial skills – Marketing skills, Strategic planning, Time Management skills, Negotiation skills.

UNIT – V **9-Hours**

Other routes for success – Joint venture – meaning, types, Advantages Acquistion – Meaning, importance advantages Merger – Advnatages, disadvantages Franchising entrpreneur's point of view, types Going public – Raising funds from the market.

Total no. of Hours = 45

TEXT BOOK:

1. Hirsch, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.

REFERENCE:

1. Kuratko, Entrpreneurship, 6th edition, Thomas learning, 2005.
2. Prasana Chandra, projects-pllaning, analysis,selection,implementation and reviews, Tata McGraw-Hill Publishing Company Limited,1996.
3. P.C.Jain (ED) HandBook for entrepreneurs, EDII, Oxford University press, New Delhi,1999.

2.

BEEER82	ELECTRICAL ENERGY GENERATION, UTILISATION & CONSERVATION	3	0	0	3

UNIT – I POWER GENERATION **9-Hours**

Review of conventional methods – thermal, hydro and nuclear based power generation. Non-conventional methods of power generation – fuel cells - tidal waves – wind – geothermal – solar - bio-mass - municipal waste. Cogeneration. Effect of distributed generation on power system operation.

UNIT – II ECONOMIC ASPECTS OF GENERATION **9-Hours**

Economic aspects of power generation – load and load duration curves – number and size of units – cost of electrical energy – tariff. Economics of power factor improvement – power capacitors – power quality. Importance of electrical energy conservation – methods – energy efficient equipments. Introduction to energy auditing.

UNIT – III ILLUMINATION **9-Hours**

Importance of lighting – properties of good lighting scheme – laws of illumination – photometry - types of lamps – lighting calculations – basic design of illumination schemes for residential, commercial, street lighting, and sports ground - energy efficiency lamps.

UNIT – IV INDUSTRIAL HEATING AND WELDING **9-Hours**

Role electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces. Brief introduction to electric welding – welding generator, welding transformer and their characteristics.

UNIT- V ELECTRIC TRACTION **9-Hours**

Merits of electric traction – requirements of electric traction system – supply systems – mechanics of train movement – traction motors and control – braking – recent trends in electric traction.

Total no. of Hours = 45

TEXT BOOKS

1. C.L. Wadhwa, ‘Generation, Distribution and Utilization of Electrical Energy’, New Age International Pvt. Ltd, 2003.
2. B.R. Gupta, ‘Generation of Electrical Energy’, Eurasia Publishing House (P) Ltd, New Delhi, 2003.

REFERENCES

1. H. Partab, ‘Art and Science of Utilisation of Electrical Energy’, Dhanpat Rai and Co, New Delhi, 2004.
2. E. Openshaw Taylor, ‘Utilization of Electrical Energy in SI Units’, Orient Longman Pvt. Ltd, 2003.
3. J.B. Gupta, ‘Utilization of Electric Power and Electric Traction’, S.K.Kataria and Sons, 2002.

BEEERE01	ADVANCED CONTROL THEORY	3	0	0	3

UNIT – I NON-LINEAR SYSTEM – DESCRIPTION & STABILITY 9-Hours

Linear vs non-linear – Examples – Incidental and Intentional – Mathematical description - Equilibria and linearisation - Stability – Lyapunov function – Construction of Lyapunov function.

UNIT – II PHASE PLANE AND DESCRIBING FUNCTION ANALYSIS 9-Hours

Construction of phase trajectory – Isocline method – Direct or numerical integration – Describing function definition – Computation of amplitude and frequency of oscillation.

UNIT – III Z-TRANSFORM AND DIGITAL CONTROL SYSTEM 9-Hours

Definition and evaluation – pulse transfer function- Digital control system- Block diagram – Signal flow graph – Discrete root locus – Bode plot.

UNIT – IV STATE-SPACE DESIGN OF DIGITAL CONTROL SYSTEM 9-Hours

State equation – Solutions – Realization – Controllability – Observability – Stability – Jury's test.

UNIT – V DISCRETE STATE SPACE ANALYSIS 9-Hours

Introduction – state space representation of discrete systems- canonical forms- state transition matrix – solving discrete time state equations.

Total no. of Hours = 45

TEXT BOOKS

1. Benjamin C. Kuo, 'Digital Control Systems', Oxford University Press, 1992
2. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.

REFERENCE BOOKS

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. Raymond T. Stefani & Co., 'Design of feed back Control systems', Oxford University, 2002.
3. William L. Luyben and Michael L. Luyben, 'Essentials of Process Control', McGraw Hill International Editions, Chemical Engineering Series, 1997.

BEEERE02	COMPUTER ARCHITECTURE&ORGANIZATION	3	0	0	3

UNIT – I INSTRUCTION SET ARCHITECTURE **9-Hours**

Introduction to computer architecture - Review of digital design – Instructions and addressing – procedures and data – assembly language programs – instruction set variations

UNIT – II ARITHMETIC/LOGIC UNIT **9-Hours**

Number representation – design of adders – design of simple ALUs – design of Multipliers and dividers – design of floating point arithmetic unit

UNIT – III DATA PATH AND CONTROL **9-Hours**

Instruction execution steps – control unit synthesis – microprogramming – pipelining – pipeline performance

UNIT – IV MEMORY SYSTEM **9-Hours**

Main Memory concepts – types of memory – cache memory organization – secondary storage – virtual memory – paging

UNIT – V I/O INTERFACE **9-Hours**

I/O devices – I/O programming – polling – interrupts – DMA – buses – links – interfacing – context switching – threads and multithreading

Total no. of Hours = 45

TEXT BOOKS:

1. B. Parhami, “Computer Architecture”, Oxford University Press, 2005.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, “Computer Organization”, Fifth Edition, Tata McGraw Hill, 2002.

REFERENCES:

1. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software interface”, Third Edition, Elsevier, 2004.
2. William Stallings, “Computer Organization and Architecture – Designing for Performance”, Seventh Edition, Pearson Education, 2006.
3. Miles Murdocca “Computers Architecture and Organization An Integrated approach”, Wiley India pvt Ltd, 2007
4. John D. Carpinelli, “Computer systems organization and Architecture”, Pearson Education, 2001.

BEEERE03	OPERATIONS RESEARCH	3	0	0	3

UNIT – I INTRODUCTION **9-Hours**

Role of Operations Research - Operations Research Models and techniques. LP model and technique – formulation and graphical Solution – graphical sensitivity Analysis. The Simplex Algorithm – the two phase method – degeneracy – alterative optima – unbounded and/or Infeasible Solution – redundancies.

UNIT – II PROBLEM FORMULATION **9-Hours**

Definitions of the Dual Problem – Primal-dual Relationship – Economic Interpretation of Duality – Dual Simplex Method – Primal Dual Computation – Post Optimal or Sensitivity Analysis – Changes Affecting Feasibility – Changes Affecting Optimality – Revised Simplex Method – LP Packages.

UNIT – III ALGORITHMS AND MODELS **9-Hours**

Definition of Transportation Model – The Transportation Algorithm – Determination of the Starting Solution – Iterative Computations of an Algorithm – The Assignment Model – The Hungarian Method – The Transshipment Model – Inter Programming Problem – Cutting Plane Algorithm.

UNIT – IV PROJECT MANAGEMENT AND INVENTORY CONTROL **9-Hours**

Definition of a project- Fulkerson's rule- PERT Network construction – critical path identification – CPM crashing – resource scheduling – inventory control functions – EOQ models for purchase manufacturing (with/without shortages) – Dynamic order quantity – ABC analysis – re order level

UNIT – V NON TRADITIONAL OPTIMIZATION ALGORITHMS **9-Hours**

Genetic algorithms – working principles – difference between GA and traditional methods – similarities between GA and optimization methods – Simulated annealing – global optimization – simple simulation procedure for the above..

Total no. of Hours = 45

TEXT BOOKS

1. Hamdy A. Taha, "Operation Research – An Introduction" ,7th Edition Person Education / Prentice Hall of India Edition, Asia, 2002.
2. Kalyanmoy Deb, " Optimization for Engineering design – Algorithm and Examples", Printice Hall of India, 2000.

REFERENCES

1. Ronald. L. Rardin ,"Optimization in Operation Research", Pearson Education, Asia, 2002.

2. JIT.S Chandran, Mahendran P.Kawatra Ki Ho Kim ,"Essential of Linear Programming", Vikas Publishing House Pvt. Ltd., New Delhi, 1994.

3.Hiller F.S, Liberman G.J ,"Introduction to Operation Research", 7th Edition, McGraw Hill, 2001.

BEEERE04	POWER SYSTEM TRANSIENTS	3	0	0	3

UNIT – I INTRODUCTION AND SURVEY **9-Hours**

Review and importance of the study of transients - causes for transients.

RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients.Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT – II SWITCHING TRANSIENTS **9-Hours**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT – III LIGHTNING TRANSIENTS **9-Hours**

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT – IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS **9-Hours**

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT - VTRANSIENTS IN INTEGRATED POWER SYSTEM **9-Hours**

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults - switching surges on integrated system
Qualitative application of EMTP for transient computation.

Total no. of Hours = 45

TEXT BOOKS

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Interscience, New York, 2nd edition 1991.
2. R.D.Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.

REFERENCES

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, 2nd edition, 2000.

BEEERE05	PRINCIPLES OF ROBOTICS	3	0	0	3

UNIT-I INTRODUCTION TO ROBOTICS 9-Hours

Automation and Robotics – Robot Anatomy – Classification of Robots by Configuration and Control – Basic Components of robots System - Manipulators, Wrists, End Effectors, Power, Control Units – Robot Sensors, Force Sensors - Introduction to AI – Legged Locomotion.

UNIT-II ROBOT MOTION ANALYSIS & CONTROL 9-Hours

Introduction to Manipulator Kinematics – Homogeneous Transformation and Robot Kinematics – Robot Dynamics – Manipulator Path Controller – Configuration of a Robot Controller – Control of a Robot Joint.

UNIT-III ROBOT DRIVE SYSTEMS 9-Hours

Introduction to Robot drives – Electric, Hydraulic and Pneumatic – Electrical Actuators – Stepper Motors, Stepper Motor Drives, Linear Stepper Motors, Brushless DC Motors, Direct Drive Actuators – Hydraulic Actuators – Pneumatic drives – Servo Amplifiers.

UNIT-IV MACHINE VISION FOR ROBOTICS 9-Hours

Introduction to machine vision – image Acquisition – Illumination Techniques – Imaging Geometry – Some Basic Relationship between Pixels – Analog to Digital Signal conversion – Image Storage – Image Processing and Analysis, Preprocessing, Segmentation, Feature Extractions, Recognition, Interpretation.

UNIT-V ROBOT PROGRAMMING AND APPLICATIONS 9-Hours

Methods of Robot programming – Lead through Programming Methods – A robot Program as a Path in space – Motion Interpolation – Weight, Signal and Delay Commands – Branching Capabilities – Robot Programming Examples for Pick and Place Application using VAL – Application of Robots in Material Handing, Processing operations, Assembly and Inspections – Future Applications of Robots.

Total no. of Hours = 45

TEXTBOOKS:

1. Richard D.Klaffer, Thomas A. Chimelewski,Michael Negain, “Robotic Engineering – An Integrated Approach”, PHI Pvt. Ltd, 1989.
2. Mikell P.Groover, Michel Wein Roger Nagel and Nicholas G.Ordy, “Industrial Robotics, Technology, Programming and Applications”, McGraw Hill, 1987.

REFERENCES:

1. B.Siciliano, “Modeling and Control of Robot Manipulators”, Tata McGraw-Hill, 1996
2. M.W.Spong and W.Vidyasagar, “Robot Dynamics and Control”, John Wiley and Sons, 1989.
3. J.J.Graig, “Introduction to Robotics, Mechanics and Control”, Addison Wesley Publishers, 1989.

BEEERE06	DIGITAL IMAGE PROCESSING	3	0	0	3

(Common for EEE, ECE)

Equivalent subject code of the ECE department: **BECE03**

UNIT – I CONTINUOUS AND DISCRETE IMAGES AND SYSTEMS 9-Hours

Light, Luminance, Brightness and Contrast, Eye, The Monochrome Vision Model, Processing Problems and Applications, Vision Camera, Digital Processing System, 2-D sampling Theory, Aliasing, Image Quantization, Lloyd Max Quantizer, Dither, Color Images, Linear Systems And Shift Invariance, Fourier Transform, Z-Transform, Matrix theory Results, Block Matrices and Kronecker Products.

UNIT – II IMAGE TRANSFORMS 9-Hours

2-D orthogonal and Unitary transforms, 1-D and 2-d DFT, Cosine, Sin e, Walsh, Hadamard, Haar, Slant, Karhunen-loeve, singular value Decomposition transforms.

UNIT – III IMAGE ENHANCEMENT 9-Hours

Point operations œ Contrast stretching, clipping and thresholding density slicing, Histogram equalization, modification and sp ecification, spatial operations œ Spatial averaging, low pass, high pass, b and pass filtering, direction smoothing, medium filtering, generalized cepstrum and homomorphic filtering, edge en hancement using 2-D IIR and FIR filters, color image enhancement

UNIT – IV IMAGE RESTORATION 9-Hours

Image observatio n models, sources of degradation, inverse and Wiener filtering, geometric mean filter, non-linear filters. Smoothing splines and interpolation, co nstrained least squares restoration.

UNIT – V IMAGE DATA COMPRESSION AND IMAGE RECONSTRUCTION FROM PROJECTION 9-Hours

Image data rates, pixels coding, predictive techniques transform coding and vector DPCM, Block truncation coding, wav elet transform coding of images, color image coding. Random transform.

Total no. of Hours = 45

Text Books :

1. Milan Sonka, Image Processing œ Analysis and Machine vision, 2ndEdition, Thomson Learning.
2. Alasdar McAndrew, Introduction to digital image processing, Thomson Learning 2004.
3. Anil K. Jain, —Fundamentals of Digital Image Processing“, PHI 1995.

Reference Books:

1. M.A.Sid Ahmed, —Image Processing“, McGraw Hill, Inc, 1995.
2. R.Gonzalazand P.Wintz, —Digital Image Processing“, Addition Wesley 2ndEd, 1987.
3. William. K.Pratt, —Digital Image Processing“, Wiley Interscience, 2ndEd, 1991.

BEEERE07	NEURAL NETWORKS AND FUZZY LOGIC	3	0	0	3

UNIT –I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS AND LEARNING LAWS **9-Hours**

Artificial neural networks and their biological motivation- Terminology- Models of neuron-Topology -characteristics of artificial neural networks - types of activation functions - learning methods - error correctionlearning - Hebbian learning - Perceptron - XOR Problem -Perceptron learning rule convergence theorem - Adaline

UNIT – II FEEDFORWARD AND RECURRENT NEURAL NETWORKS 9-Hours

Feedforward networks: Multilayer Perceptron- BackPropagation learning algorithm - Universal functionapproximation - Associative memory: autoassociation, heteroassociatio, recall and cross talk Recurrent neural networks: Linear auto associator - Bi-directional associative memory - Hopfield neural network Travelling Salesman Problem

UNIT – III UNSUPERVISED LEARNING AND SELF ORGANIZINGNETWORKS

9-Hours

Competitive learning neural networks - Max net - Mexican Hat - Hamming net - Kohenen Self organizing Feature Map - Counterpropagation - Learning Vector Quantization - Adaptive Resonance Theory Applications of neural networks in image processing, signal processing, modeling and control.

UNIT – IV FUZZY SETS AND FUZZY RELATIONS **9-Hours**

Introduction -classical sets and fuzzy sets -classical relations and fuzzy relations -membership functions -fuzzy to crisp conversions -fuzzy arithmetic, numbers, vectors, and extension principle

UNIT – V FUZZY DECISION MAKING AND NEURO FUZZY **9-Hours**

Classical logic and fuzzy logic -fuzzy rule based systems -fuzzy nonlinear simulation -fuzzy decision making -fuzzy control systems -fuzzy optimization - one-dimensional optimization. Mathematical formulation of adaptive neurofuzzy inference systems.

Total no. of Hours = 45

Text Books:

1. Jacek M. Zurada, 'Introduction to Artificial Neural Systems', Jaico Publishing home, 2002.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.

Reference Books:

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. H.J. Zimmermann, 'Fuzzy Set Theory & its Applications', Allied Publication Ltd., 1996.
3..Imon Haykin, 'Neural Networks', Pearson Education, 2003.
4. John Yen & Reza Langari, 'Fuzzy Logic - Intelligence Control & Information', Pearson Education, New Delhi,2003

BEEERE08	POWER QUALITY	3	0	0	3

UNIT – I POWER QUALITY **9-Hours**

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations.

UNIT – II VOLTAGE SAGS AND INTERRUPTIONS **9-Hours**

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT – III TRANSIENTS AND GROUNDING **9-Hours**

Over voltage analysis – sources of transient over voltages – Principles of over voltages protection – transients types. Grounding – reasons for grounding – typical wiring and grounding problems.

UNIT - IV HARMONICS **9-Hours**

Harmonic sources from commercial and industrial loads, locating harmonic sources. Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters

UNIT – V POWER QUALITY MONITORING **9-Hours**

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer –
quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

Total no. of Hours = 45

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5)

REFERENCES

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999)
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', (New York: Wiley, 1999)
4. PSCAD User Manual.

BEEERE09	COMPUTER NETWORKS	3	0	0	3

(Common for EEE, CSE)

Equivalent subject code of the CSE department: **BCS302**

UNIT – I INTRODUCTION 9-Hours

The uses of computer networks - Network hardware - Network software - Reference model Example of networks- Network standardization.The physical layer: The theoretical basis for data communication - Guided Transmission media - Wireless transmission - Mobile telephone -Communication satellite.

UNIT – II DATA LINK LAYER 9-Hours

Data link layer design issues - Error detection and correction - Elementary data link protocols - Sliding window protocols - Example of data linkprotocols- ETHERNET - 802.11 , 80 2.16, Bluetooth.

UNIT – III NETWORK LAYER 9-Hours

Network layer design issues - Routing algorithms - Congestion control algorithms - Internetworking- Network layer in Internet.

UNIT – IV TRANSPORT LAYER 9-Hours

Transport layer design issu es - Transport protocols - Simple transport protocol - Internet transport protocols UDP, TCP.

UNIT – V APPLICATION LAYER 9-Hours

Domain name system - Electronic mail - World Wide Web - Multimedia - Cryptography, Digital signature- Communication Security.

Total no. of Hours = 45

TEXT BOOK:

1. Andrew S. Tanenbaum, —Computer n etworks —, PHI, 4 t hedition 2002 .

REFERENCES:

1. William Stallings,“ Data and computer communications“, PHI, 2001
2. Douglas E. comer,“ Internetworking with TCP/IP-Volume-I“, PHI, 1997
3. Godbole, —Data communication and networking“, TMH, 2004.
4. Forouzan B. A., —Data Communications and network ing“, TMH, 2003.

BEEERE10	WEB TECHNOLOGY	3	0	0	3

(Common for EEE, CSE)

Equivalent subject code of the CSE department: **BCS306**

UNIT I - INTRODUCTION TO HTML **9-Hours**

Introduction to HTML, web publishing - Process of web publishing, Implementation, Phases of website development, HTML's Role in the web,Issues facing HTML documen ts, Documents typ es, HTML Elements.Links & Addressing:Links, Basics, URL Concepts, Links in HTML, Anchor attributes, Images & anch ors, Image maps, <links> & <META> tags, HTML & images.Presentation & Layouts: Layout with tables, Frames, Layers, HTML & other media types -HTML & binary objects, <MARQUEE> tag, Audiosupport in browser, Video support, Style sheet basics, Style sheet properties, Positions with style sheet, CSS2. Programming & HMTL: HTML forms basics, <FORM> element, Form controls, Server side programmed, Counter gateway interface, Coldfusion,

UNIT II - Site Delivery & XML: **9-Hours**

Delivering the website, Virtual hosting, Running a local web server Working of web server, Relationship any HTML, SGML & XML, BasicXML, Ways to use XML, Rewriting HTML as XML, Future of XML20

UNIT- III JAVA SCRIPT **9-Hours**

Java script/VB Script, Active server pag es, Purpose of scripts, Scripts in an HMTL document, Script events & HTML, Client side p rogramming &HTML, JSP

UNIT- IV WEB SERVER **9-Hours**

Web Server (Tomcat) and Servlet

UNIT -V APPLICATIONS **9-Hours**

A small website application which has to retrieve the data from a database and displays it

Total no. of Hours = 45

TEXT BOOK:

THOMAS A.POWELL, The Complete Referen ce HTML, 2nd Edition - Tata McGraw Hill,

BEEERE11	TOTAL QUALITY MANAGEMENT	3	0	0	3

UNIT – I INTRODUCTION **9-Hours**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT –II TQM PRINCIPLES **9-Hours**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT–III TQM TOOLS & TECHNIQUES **9-Hours**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT–IVTQM TOOLS & TECHNIQUES II **9-Hours**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT–V QUALITY SYSTEMS **9-Hours**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

Total no. of Hours = 45

TEXT BOOK

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

REFERENCES

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd. (2006)

BEEERE12	BIO MEDICAL MEASUREMNTS & INSTRUMENTATION	3	0	0	3

UNIT – I PHYSIOLOGY AND TRANSDUCERS 9-Hours

Cell and its structure – Resting and Action Potential – Nervous system: Functional organisation of the nervous system – Structure of nervous system, neurons - synapse – transmitters and neural communication – Cardiovascular system – respiratory system – Basic components of a biomedical system - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT – II ELECTRO – PHYSIOLOGICAL MEASUREMENTS 9-Hours

Electrodes –Limb electrodes –floating electrodes – pregelled disposable electrodes – Micro, needle and surface electrodes – Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier. ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms.Electrical safety in medical environment: shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments

UNIT – III NON-ELECTRICAL PARAMETER MEASUREMENTS 9-Hours

Measurement of blood pressure – Cardiac output – Heart rate – Heart sound – Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers : pH of blood –measurement of blood pCO_2, pO_2, finger-tip oxymeter - ESR, GSR measurements .

UNIT – IV MEDICAL IMAGING 9-Hours

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems and patient monitoring – Introduction to Biometric systems

UNIT – V ASSISTING AND THERAPEUTIC EQUIPMENTS 9-Hours

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy

Total no. of Hours = 45

TEXT BOOKS

1. R.S.Khandpur, 'Hand Book of Bio-Medical instrumentation', Tata McGraw Hill Publishing Co Ltd., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, 'Bio-Medical Instrumentation and Measurements', II edition, Pearson Education, 2002 / PHI.

REFERENCES

1. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
2. L.A. Geddes and L.E.Baker, 'Principles of Applied Bio-Medical Instrumentation', John Wiley & Sons, 1975.
3. J.Webster, 'Medical Instrumentation', John Wiley & Sons, 1995.
4. C.Rajarao and S.K. Guha, 'Principles of Medical Electronics and Bio-medical Instrumentation', Universities press (India) Ltd, Orient Longman ltd, 2000.

BEEERE13	HVDC TRANSMISSION	3	0	0	3

UNIT – I INTRODUCTION **9-Hours**

Introduction of DC Power transmission technology – Classification of HVDC links- Components of HVDC transmission system- Comparison of AC and DC- Planning and Modern trends in DC transmission.

UNIT - IIANALYSIS OF HVDC CONVERTERS **9-Hours**

Pulse number – Choice of converter configuration – Simplified analysis of Graetz circuit – Converter bridge characteristics – Characteristics of a twelve pulse converter – Detailed analysis of converters.

UNIT – III CONVERTER AND HVDC SYSTEM CONTROL **9-Hours**

General – Principles of DC Link Control- Convertor control characteristics – System control Hierarchy – Firing Angle control – Current and Extinction angle control – Starting and stopping of DC Link – Power Control.

UNIT – IV HARMONICS AND FILTERS **9-Hours**

Introduction – Generation of harmonics – Design of AC filters and DC filters – Interference with neighbouring communication lines.

UNIT – V HVDC CABLES AND MODELLING OF HVDC SYSTEMS **9-Hours**

Introduction of DC cables – Basic physical phenomenon arising in DC insulation – Practical dielectrics – Dielectric stress consideration – Economics of DC cables compared with AC cables Introduction to Modelling- Representation for power flow solution- Per unit system for DC quantities.

Total no. of Hours = 45

TEXT BOOK

1. Padiyar, K. R., “HVDC power transmission system”, Wiley Eastern Limited, New Delhi 1990. First edition.
2. Edward Wilson Kimbark, “Direct Current Transmission”, Vol. I, Wiley interscience, New York, London, Sydney, 1971.

REFERENCES

1. Colin Adamson and Hingorani N G, “High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
2. Arrillaga, J., “High Voltage Direct Current Transmission”, Peter Pregrinus, London, 1983.
3. Rakosh Das Begamudre, “Extra High Voltage AC Transmission Engineering”, New Age Interantional (P) Ltd., New Delhi, 1990.
4. P. Kundur, ‘Power System Stability & Control’, McGraw Hill Publications, USA, 1994.

BEEERE14	PROGRAMMABLE LOGIC CONTROLLERS	3	0	0	3

UNIT-I INTRODUCTION 9-Hours

Programmable controller—need for PLC—modular PLC and fixed PLC—block diagram of PLC Input-output modules—power supply—types of PLC system

UNIT-II HARDEWARE DESIGN 9-Hours

CPU—processor's function—processor's operating system—processor ports—interfacing PC to PLC—processor operating modes—PLC system memory and application memory—input modules—output modules—module selection—Plc internal operation and signal processing—input and output processing—timing consideration.

UNIT – III PROGRAMMING OF PLC SYSTEM 9-Hours

System functions-sequence control- ladder programming- ladder diagrams-- logic functions-Standard PLC functions—special function relays—data handling instructions-arithmetic Instructions—data manipulation—program subroutines—programming examples.

UNIT – IV PLC COMMUNICATION AND AUTOMATION 9-Hours

PLC communication ports—serial communications—RS232—standard requirements—communication between several PLCs—programmable controllers and networks-distributed control system(DCS)— building blocks--descriptions and functions of field controlled units—operator stations—data highways—redundancy concepts—DCS system integration with PLC and computers—communication in DCS-Manufacturing Automation Protocol(MAP)—Technical Office Protocol(TOP).

UNIT- V APPLICATIONS AND PLC MAINTENANCE 9-Hours

PLC as robot controller and FMS—PLC to factory automation—PLC in process control—PLC Maintenance—internal PLC faults—faults external to PLC—programmed error—watch dogs—Safety—hardware safety circuits—troubleshooting.

Total no. of Hours = 45

TEXT BOOKS:

1. Programmable Logic controllers, W Bolton, 4th Edition, Elsevier-newness, 2006
2. Programmable Logic Controllers- Principles and Applications, John W Webb, Ronald A Reis, 5th Edition 2nd Impression Pearson Education, 2007

REFERENCE BOOKS:

1. Programmable Controllers Operation and Application—Ian G.Warnock,Prentice Hall International,UK,1992 .
2. Programmable Controllers – An Engineers' Guide, E A Paar, 3rd Edition, newness, 2003
3. Computer Based Industrial Control—Prentice Hall of India,1997.

BEEERE15	OPERATING SYSTEMS	3	0	0	3

(Common for EEE, CSE)

Equivalent subject code of the CSE department: **BCS307**

UNIT – I INTRODUCTION **9-Hours**

Mainframe systems œ Desktop systems œ Multiprocessor systems - Distributed systems œ Cluster Systems œ Real time systems-HardwareProtection-System Components-Han dheld Systems-Operating System Serv ices-System Calls-System Programs-System Structure-VisualMachines-System Design and Implementation.

UNIT – II PROCESS MANAGEMENT **9-Hours**

Process co ncept-Process Scheduling-Operation on Process-Cooperating Processes-InterProcess Communication-Threads-Overview-
Multithreading Models. CPU Scheduling-Basic Concepts-Scheduling Criteria-Scheduling Algorithms-Multiple-Processor Scheduling-Real TimeScheduling-Algorithm Evaluation

UNIT – III SYNCHRONIZATION AND DEADLOCKS **9-Hours**

Process Synchronization-The Critical Section Problem-Synch ronization Hardware-Semaphores-Classical Problems Of Synchronization-Deadlocks-System Model-Deadlock Characterization-Methods of Handling Deadlocks-Deadlock Prevention-Deadlock Avoidance-Dead lockDetection-Recovery form Deadlock.

UNIT – IV MEMORY MANAGEMENT **9-Hours**

Background-Swapping-Contiguous Memory Allocation - Virtual Memory œ Address Translation œ Paging œ Segmentation œ Segmentation withPaging. - Static Paging Algorithm œ Dynamic Paging Algorithm

UNIT – V FILES AND SECONDARY STORAGE MANAGEMENT **9-Hours**

File Systems œ File Con cepts œ Access Methods œ Directory Structure œ File System Mounting œ File Sharing œ Protection œ File System Structureœ File System Implementation œ Recovery œ Disk Structure œ Disk Scheduling œ Disk Management

Total no. of Hours = 45

Text Book:

Silberschatz, Galvin, GAGNE —Operating System Concepts“ 6 t hEdition John Wiley & Sons INC, 2002

Reference:

1. D.M.Dhamdhere, —Operating Systems“, Tata McGraw Hill, 2002
2. Charles Crowley, —Operating Systems: A Design Oriented Approach“, Tata McGraw Hill 1999.
3. Andrew S. Tanenbaum, —Modern Operating Systems“, Prentice Hall of India, 1995.
4. William Stallings, —Operating Systems“, Prentice Hall of India, 1997.

BEEERE16	NON-CONVENTIONAL ENERGY SOURCES	3	0	0	3

UNIT-I **9-Hours**

General: primary and commercial energy sources – study of availability, energy consumption pattern and growth rate in India .Non commercial energy sources – Availability, Economics, and efficiency.

UNIT-II **9-Hours**

Solar energy and applications: Solar radiation – principles of solar energy collection – types of collector – characteristics and principles of different types of collector and their efficiencies - Solar energy applications – Water heaters, air heaters, solar cooling, solar drying and power generation – Solar tower concept (solar plant) – solar pump.

UNIT-III **9-Hours**

Wind energy: Energy from the wind – General theory of wind mills – types of wind mills – performance of wind machines – wind power - efficiency.

UNIT-IV **9-Hours**

Tidal energy: Energy from tides and waves – working principles of tidal plants – tidal power generations – geothermal energy – principle of working of geothermal power plants.

UNIT-V **9-Hours**

Bio – energy: Energy from Bio – mass – Biogas plants – various types – Industrial wastes – municipal waste – Burning plants – Energy from the Agricultural wastes – Applications.

Total no. of Hours = 45

TEXT BOOKS:

1. S.P.Sukhatme, “Solar Energy- Principles of thermal collection and storage”, Tata McGraw Hill Publishers, Fourth Print, February 1989.
2. G D Rai, “Solar Energy Utilization”, Khanna Publishers, Second revised edition, 1984.
3. Ronald Shaw, “Wave Energy- A Design Challenge”, Ellis Horwood Limited publishers, First edition, 1982.Putnam, “Energy from the wind”, Prentice Hall of India, 2001.

BEEERE17	FLEXIBLE AC TRANSMISSION SYSTEM	3	0	0	3

UNIT –I INTRODUCTION **9-Hours**

The concept of flexible AC transmission - reactive power control in electrical power transmission lines -uncompensated transmission line – series and shunt compensation. Overview of FACTS devices - Static Var Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified Power Flow controller (UPFC) - Integrated Power Flow Controller (IPFC).

UNIT – II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9-Hours

Voltage control by SVC – advantages of slope in dynamic characteristics – influence of SVC on system voltage. Applications - enhancement of transient stability– enhancement of power system damping – prevention of voltage instability.

UNIT – III THYRISTOR CONTROLLED SERIES CAPACITOR(TCSC)AND APPLICATIONS 9-Hours

Operation of the TCSC - different modes of operation – modeling of TCSC – variable reactance model – modeling for stability studies. Applications - improvement of the system stability limit – enhancement of system damping – voltage collapse prevention.

UNIT – IV EMERGING FACTS CONTROLLERS 9-Hours

Static Synchronous Compensator (STATCOM) – operating principle – V-I characteristics – Unified Power Flow Controller (UPFC) – Principle of operation - modes of operation – applications

UNIT – V POWER FLOW MODEL LING **9-Hours**

Power flow modeling of SVC, TCSC, STATCOM and UPFC.

Total no. of Hours = 45

TEXT BOOK:

1. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc.
2. E. ACHA etal,. “Power Electronic Control in Electrical Systems”, Newnes Power Engineering Series

REFERENCES:

1. A.T.John, “Flexible AC Transmission System”, Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. Narain G.Hingorani, Laszio. Gyugyl, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, Standard Publishers, Delhi 2001.

BEEERE18	INTRODUCTION TO VLSI	3	0	0	3

UNIT – I BASIC MOS TRANSISTOR **9-Hours**

Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – second order effects – MOS Transistor Model.

UNIT – II NMOS & CMOS INVERTER AND GATES **9-Hours**

NMOS & CMOS inverter – Determination of pull up / pull down ratios – stick diagram – lambda based rules – super buffers – BiCMOS & steering logic.

UNIT – III SUB SYSTEM DESIGN & LAYOUT **9-Hours**

Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND-NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

UNIT – IV DESIGN OF COMBINATIONAL ELEMENTS & REGULAR ARRAYLOGIC

9-Hours

NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA, CPLD.

UNIT –V VHDL PROGRAMMING **9-Hours**

RTL Design – Detructured level Design -combinational logic – Types – Operators – Packages – Sequential circuit – Sub programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / Demltiplexers).

Total no. of Hours = 45

TEXT BOOKS

1. D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2003.
2. Eugene D.Fabricius, ‘Introduction to VLSI Design’, Tata McGraw Hill, 1990.

REFERENCES

1. N.H.Weste, ‘Principles of CMOS VLSI Design’, Pearson Education, India, 2002.
2. Charles H.Roth, ‘Fundamentals of Logic Design’, Jaico Publishing House, 1992.
3. Zainalatsedin Navabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2n Edition, Tata McGraw Hill, 1998.
4. Douglas Perry, ‘VHDL Programming By Example’, Tata McGraw Hill, 3rdEdition.2007.
5. Parag K.Lala, ‘Digitl System Design using PLD’, BS Publications, 2003.

BEEERE19	SPECIAL ELECTRICAL MACHINES	3	0	0	3

UNIT – I SYNCHRONOUS RELUCTANCE MOTORS 9-Hours

Constructional features – Types – Axial and Radial flux motors – Operating principles – Variable Reluctance and Hybrid Motors – SYNREL Motors – Voltage and Torque Equations - Phasor diagram - Characteristics.

UNIT – II STEPPING MOTORS 9-Hours

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitations – Characteristics – Drive circuits – Microprocessor control of stepping motors – Closed loop control.

UNIT – III SWITCHED RELUCTANCE MOTORS 9-Hours

Constructional features – Rotary and Linear SRMs - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensorless operation – Closed loop control of SRM - Characteristics.

UNIT – IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9-Hours

Permanent Magnet materials – Magnetic Characteristics – Permanent coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power controllers – Motor characteristics and control.

UNIT –V PERMANENT MAGNET SYNCHRONOUS MOTORS 9-Hours

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature reaction MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements.

Total no. of Hours = 45

TEXT BOOKS

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

BEEERE20	MEMS	3	0	0	3

UNIT – I INTRODUCTION **9-Hours**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Microfabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT – II SENSORS AND ACTUATORS-I **9-Hours**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators.

UNIT – III SENSORS AND ACTUATORS-II **9-Hours**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT – IV MICROMACHINING **9-Hours**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micromachining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – Assembly of 3D MEMS – Foundry process.

UNIT – V POLYMER AND OPTICAL MEMS **9-Hours**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Total no. of Hours = 45

TEXT BOOKS.

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006.

REFERENCES

1. Nadim Maluf, " An introduction to Micro electro mechanical system design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
4. Julian w. Gardner, Vijay k. varadan, Osama O.Awadelkarim,micro sensors mems and smart devices, John Wiley & son LTD,2002
5. James J.Allen, micro electro mechanical system design, CRC Press published in 2005