List of M.Sc. by Research / Ph.D. course work subjects that can be offered under Electrical Engineering Group from 2012 onwards

Group I		Group II		Group III		Group IV	
Subject Code	**Name of the subject**	**Subject Code**	**Name of the subject**	**Subject Code**	**Name of the subject**	**Subject Code**	**Name of the subject**
10EMS21	Optimal control systems	10EEM151	Computer Modeling of Electrical Power System	10EPS251	Power System Instrumentation	**10ECD21**	Dynamics of Linear systems
10ECD152	VLSI Design	10EEM152	Switched mode Power Conversion	10EEM21	Photo-Voltaic Cells	10EPS321	Energy Management Systems
10ECD153	Advanced Network analysis and Synthesis	10EEM322	Bio-Mass Energy Resources	10EPS 13	Solid State Relays & Protection	10SCE253	Advances in Digital Image Processing
10EPS22	Distribution System Design & Control	10EEM153	Engineering Economics & Management	10EPS332	Over Voltage Phenomena In Power System	10EC126	Real Time Operating Systems
10ECD322	Optimization and Robust Control	10EEM251	AI Applications to Energy Management	10EPE332	FACTs Controllers	10EPS253	Non Linear Automatic Control theory
10ECD333	Discrete Control Systems and Multi Variable Control	10EEM252	Environmental Engineering and Pollution Control	10SSE21	Topics in Software Engineering – II	10EPS252	AI Applications to Power System
10EMS11	Analysis of Linear Systems	10EEM24	Computer Aided Power System Operation & Analysis	10EPS153	High Voltage Power transformers	10EPS31	Power System Reliability Engineering
10EC006	Advanced Digital Communications	10EPE21	AC-DC Drives	10EEM332	Environment Aspects of Power Generation & Transmission	10EMS323	Computer Control of Industrial Drives
10SCN22	Client-Server Programming	10SSE331	Distributed Operating Systems	10EC119	Broadband Wireless Network	10SCS23	Advances in Computer Architecture
10SCE153	Data structures & Algorithms in C++	10SSE152	Computer Graphics and visualization	10SCE321	OOAD and Design Patterns	10EC060	Pattern Recognition
10ECD254	Intelligent applications in electrical systems	10SSE13	Topics in Database Systems	10EC124	Probability & Random Process	10SSE333	Embedded Computing Systems
10SCE323	Advances in Digital Signal Processing	10SCS21	Formal Models in Computer Science	10SCS252	Topics in Artificial Intelligence	10SCE252	Data warehousing and Data Mining
10SSE151	Advances in Compiler Design	10SCN153	System Modeling and Simulation	10SCS22	Advanced Algorithms	10SCS321	Wireless and Cellular Networks
10SCN12	Computer Networks	10SSE31	Topics in Software Architectures	10SSE23	Topics in Software Testing	10SSE153	Computer Systems Performance Analysis
10SSE11	Topics in Software Engineering – I	10SCN323	Advances in Storage Area Networks	10EC052	Multimedia Communication	10EC093	Modern Spectral Analysis & Estimation

10EC131	Wireless and Mobile Networks	10EC056	Network Programming	10EPE12	Power Semi Conductor Devices	10EPE153	Electrical Machine Dynamics
10EC023	Cryptography & Network Security	10EC026	Design of Power Converters	10ECD253	Computer control of electric Drives	10EC127	RF MEMS
10EPE253	Electro Magnetic Compatibility	10EMS333	Testing and Verifications of VLSI Circuits	10SCE332	Advances in Pattern Classification	10EPE23	Power Electronics System Design using ICs
10LBI251	Theory & Design of Biomedical Instruments	10EPE24	HVDC Power Transmission	10EC020	CMOS RF Circuit Design	10EC025	Design of analog & mixed mode VLSI Circuits
10EC005	Advanced Control Systems	10EC039	Error Control Coding	10EC068	Radar Systems	10EC086	Wireless Communication
10EC010	Algorithms for VLSI Design Automation	10EC012	ASIC Design	10EC044	Java Technology	10LBI253	Biosensors
10EC011	Antenna Theory and Design	10EC028	Detection & Estimation	10EC126	Real Time Operating Systems	10EC047	Low Power VLSI Design
10EC017	Biomedical Signal Processing	10LBI334	Ergonomics	10SCN14	Information Security	10EC077	Synthesis & Optimization of Digital Circuits
10EC027	Design of VLSI system	10EPE151	Embedded system design	10EPE321	CMOS VLSI Design	10EC075	Speech &Audio Processing
10EC029	Digital Circuits & Logic Design	10EC121	Digital System Design Using Verilog	10EC050	Mobile Computing	10EC055	. Net Technology
10EC030	Digital Signal Compression	10EC043	Image & Video Processing	10EC076	Statistical Signal Processing	10EC071	RF & Microwave Circuit Design
10EC033	Distributed Computing	10EC040	Ethernet Technology	10EC084	Web Services	10EPE333	DSP Applications to Power Electronics
10EC046	Linear Algebra	10EC125	Protocol Engineering	10EMS31	High speed VLSI Design	10EC059	Optical Communication & Networking
10EC057	Network Protocol Design	10SSE321	Soft Computing	10LBI31	Bio-MEMS & Nanotechnology		
10EC132	Wireless Sensor Networks	10EPE11	Applied Mathematics				
10EC054	Nanoelectronics	10LBI254	Bioinformatics and Applications				
		10EPS14	Advanced Power System Analysis & Stability				

Group I

10EMS21
OPTIMAL CONTROL SYSTEMS

Introduction. static and dynamic optimization. Parameter optimization.Caculus of Variations : problems of Lagrange,. Mayer and Bolza. Euler-Language equation and transversality conditions, Lagrange multipiliers. Pontryagin's maximum principle; theory; application to minimum time, energy and control effort problems, and terminal control problem.

Dynamic programming : Belaman's principle of optimality, multistage decision processes. application to optimal control.
Linear regulator problem : matrix Riccati equation and its solution, tracking problem.

Computational methods in optimal control. application of mathematical programming singular perturbations, practical examples.

REFERENCE BOOKS:

1. D.E.Kirk, Optimal Control Theory, Prentice-Hall. 1970.
2. A.P.Sage and C.C.White II, Optimum Systems Control, 2nd ED., Prentice-Hall, 1977.
3. D.Tabak and B.C.Kuo, Optimal Control by Mathematical Programming, Prentice-Hall, 1971.
4. B.D.O. Anderson and J.B.Moore, Linear Optimal Control, Prentice-Hall, 1971.

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10ECD152
VLSI DESIGN

Introduction -VLSI technology trends, Moore's law.

Difference between MOS and BJT's , MOS transistor characteristics, types of MOS transistors, NMOS & CMOS inverters, and transmission gated structure. Operation of inverter circuits.

NMOS & CMOS circuits for combinational and sequential logics, stick notation, Shannon's expansion theorem, realization of Boolean functions. PLA generators, Pseudo NMOS circuits, Clocked logic, Simple flip flop realization, Shift registers, dynamic shift registers, super buffers, RAMs and ROMs,

VLSI fabrication techniques, Lithographic process, Twin-tub and SOS process, Design rules, specification of layers.

Delay and timing calculation, power estimation.

System design: VLSI Design level system, design examples.

CAD tools for VLSI Design, Design steps CIF representation, Design Styles, placement, routing, and simulation. Circuit extraction, design rule, checking algorithms. Testability and fault tolerances, silicon compilers (in brief)

REFERENCE BOOKS:

1. Mead, Conway, "**Introduction to VLSI Systems"**, Addison Wesley.
2. Mukherjee Amar, "**Introduction to NMOS and CMOS VLSI System Design**", Prentice Hall India.
3. Pucknell, Eshtangina, "**Basic VLSI Design systems & circuits**", Prentice Hall India.
4. Niel H E Weste, Kamran Eshranghian, **"Principles of VLSI design"**, Pearson Edu Asia.1993.

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10ECD153
ADVANCED NETWORK ANALYSIS AND SYNTHESIS

Network Topology: open circuit and short circuit, operations, indefinite admittance matrix; Tellegen and Minsky Theorem, application, Implicit duality, multiport decomposition, adjoint network, decomposition through altering topology.

Formulation of state equations through graph theoretic methods, equivalent source methods. Approximation, Response of filters, butterworth, Chebyshev, Inverse Chebyshev, Bessel –Thomson filters, frequency transformation.

Active Networks : Element nullator, norator models, higher order networks.

Network Synthesis: Review of PR function, two –element kind network synthesis, RL, RC and LC networks.

Realization of driving point impedance, Brune, darlington and Bott –Duffin methods, Driving point impedance without mutual inductance.

Realization of Transfer function, ladder and lattice networks, Quadri-poles terminated with resistances.

REFERENCE BOOKS:

1. Seshu.S.red M.B, "**Linear Graph and electric Networks**", Addison Wesley, 1961.
2. Seshu S. Balbanian N. Linear, "**Network Analysis**", John Wiley, 1959.
3. Narayanan H., "**Sub-Modular Functions and Electric Networks**", annals of Discrete Math. Vol. 54 North Holland 1997.
4. Norma Balbanian, Bickart Theodore A, "**Electrical Network Theory**", John Wiley.
5. Aatre, V.K. "**Network Theory and Filter Design**", New Age Int.P.1980.
6. Swamy, M.N.S., Thulasiraman K. Graphs, "**Networks and Algorithms**", John Wiley, 1981.

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10EPS22
DISTRIBUTION SYSTEM DESIGN AND CONTROL

Distribution system planning & Automation: Introduction, Distribution system planning; factors affecting system planning, present technique, Role of computers in distribution planning, Distribution Automation, local energy control center, Typical control applications.

Distribution Substation; Introduction, Load characteristics, substation location, Rating a distribution substation, sub station services area with 'n' primary feeders, Comparison of four and six feeder patterns, derivation of K constant, substation Application curves, present voltage drop formula.

Primary and Secondary Distribution Systems: Introduction, feeder types and voltage levels, feeder loading rectangular type development, radial type development application of the A, B, C, D general circuit constants to radial feeders, secondary banking.

Application of Capacitors in Distribution Systems: Introduction, Power capacitors series and shunt power factor Correction, economic power factor, applications of capacitors and installation, types of control, economic justification, practical procedure to determine the best location, mathematical procedure for optimum- allocation, Dynamic behavior of distribution system.
Artificial Intelligence Methodologies in Distribution System Operation *&* Control: Introduction, Expert system, knowledge based system, simulated annealing technique for loss minimization and voltage control. Knowledge based methodologies for .system reconfiguration and service restoration.

REFERENCE BOOKS*:*

1. Turan Gonen, "**Electric Power Distribution System Engineering**", McGraw Hill.
2. A.S,Pabla, "**Electric Power Distribution System", Second Edition**, TMH.
3. Gorti Ramamurthy **,Hand Book of Electrical Power Distribution,**University Press,2nd Edition,2009.

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10ECD322
OPTIMIZATION AND ROBUST CONTROL

Introduction-Static and Dynamic Optimization, Formulation of Optimal Control Problems, performance measure-types.

Dynamic Programming-Principle of Optimality, Application to Optimal control problems, examples. Recurrence relation of dynamic programming, Principle of imbedding, computational procedure, characteristics.
Hamilton-Jacobi-Bellman Equations, continuous time linear regulator problems, Matrix Riccatti equation, Infinite and finite time problems, examples

Variational Calculus: Introduction, Definitions, Euler-Language Equation, Transversality condition, Evaluation of extremal for free/fixed end point problems, examples

Variational approach to Optimal control problem: Necessary conditions, Linear regulator problem using Variational approach, output regulator problem, tracking problem, Pontryagin's minimum principle

Robustness Issues-Model Uncertainty, H2 Optimal Control, H_{infty} Control (simple case), General Hinfty Solution, H_2-H_{infty} integral control (qualitative).
Introduction to Observers and Kalman filter, LQG/Loop transfer recovery.

REFERENCE BOOKS:

1. Kirk D.E., "Optimal Control Theory-An Introduction", Prentice Hall 1970.
2. Sage A.P. and White C.C., "Optimum Systems Control" 2 edn. Prentice Hall, 1977.
3. F. L. Lewis and V.L. Syrmos, "Optimal Control", 2 End. John Wiley and Sons, 1995.
4. K. Zhou, J.C. Doyle, and K. Glover, "Robust and Optimal Control", Prentice Hall 1996.
5. B.O. Anderson and J.B. Moore, "Optimal Control-Linear Quadratic Methods", Prentice Hall, 1990.
6. S. Skogestad and I. Postlethwaite, "Multivariable Feedback control, Analysis and Design", John Wiley and Sons, 1996.

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10ECD333
DISCRETE CONTROL SYSTEMS AND MULTI VARIABLE CONTROL

Design of discrete lime systems using Transform methods; Stability analysis of closed loop systems in the Z - domain- the jury stability test.

Introduction, obtaining discrete time equivalent of continuous time fillers, design principles based on a discrete time equivalent of analog controller, transient find steady state response analysis, design based on the root locus method,design based on the frequency response method, Analytical design method.

Multi variable System models, state equations, canonical forms, polynomial matrices, transmission zeroes, Multi variable system analysis, solution of state equations, controllability, stabilizability.

Observer theory, Realization of transfer matrices, minimal realization, Multi variable system design, pole placement, decoupling model matching, Inverse Nyquist array, characteristic locus methods.

REFERENCE BOOKS:

1. Ogata, "**Discrete Time Control Systems**".
2. B.C Kuo, "**Automatic Control System**" .
3. G.F. Franklin, J. David Powell, Michael L. "**Digital Control Of Dynamics Systems**", Warkman, II Edition.
4. Owens, D. H, "**Feed Back and Multi Variable Systems**" Peter Peregrines, 1978.
5. Wonhans .W.M. "**Multi Variable Control",** springer Verlag , ed2 1997.

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10EMS11
ANALYSIS OF LINEAR SYSTEMS

Linear Control systems: Review, Analytic & experimental modeling. Review of Transfer

Function Representation, Analysis-Time & harmonic response. Frequency response Specifications, random inputs.

State Space Analysis: SISO, MIMO system Analysis-Solution-Impulse response matrix, Controllability-Observability, Observers, Observer based feedback.

Composite System-Parallel, Feedback & Tandem-Concept of State Feedback, State Estimators-pole placement methods.

Stability Analysis-Lyapunov's Stability Criteria, generating Lyapunov function, testing for stability.
Introduction to phase lag, lag- lead, lead, PID controllers.
Digital Control Systems, Sampling &data reconstruction, Sampling theorem, hold operation.

Z-transform-properties, inverse, solution of difference equation, System function, Pole-Zero location, frequency consideration.

State Variable methods of analysis of Digital Control Systems, PID controller brief introduction.

Stability Analysis of Digital Control Systems by Jury's Criteria and Bilinear transformation

REFERENCE BOOKS:

1. Chen C.T., Linear System Theory and Design,Holt, Rinehart,Winston,1984.
2. Blackman,P.E., Introduction to State Variable Analysis,Macmillan Press,1977.
3. Kuo,B.C., Digital Control Systems..
4. Franklin,Powell., Digital Control Systems.
5. Ogata.K., Discrete Time Control Systems,Addison Wesley Longman,Ed.2,2000.
6. Power, H.M., Introduction to Dynamics and control, Mcgraw Hill,1978.
7. Nisse, Control Systems Engineering,John water ED.4 2005.
8. Phillips- Digital Control Systems Analysis Design.
9. Gopal.M.,Digital Control and State Variable methods.
10. Alok Sinha, Linear Systems,CRC Press,Indian Edition,2007.

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10EC006
ADVANCED DIGITAL COMMUNICATIONS

Digital Modulation Techniques: QPSK, DPSK, FQPSK, QAM, M-QAM, OFDM, Optimum Receiver for Signals Corrupted by AWGN, Performance of the Optimum Receiver for Memory-less Modulation, Optimum Receiver for CPM Signals, Optimum Receiver for Signals with Random Phase in AWGN Channel.

Coding Techniques: Convolutional Codes, Hamming Distance Measures for Convolutional Codes; Various Good Codes, Maximum Likelihood Decoding of Convolutional codes, Error Probability with Maximum Likelihood Decoding of Convolutional Codes, Sequential Decoding and Feedback Decoding, Trellis Coding with Expanded Signal Sets for Band-limited Channels, Viterbi decoding.

Communication through band limited linear filter channels: Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision-feedback equalization, reduced complexity ML detectors, Iterative equalization and decoding-Turbo equalization.

Adaptive Equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, adaptive equalization of Trellis- coded signals, Recursive least squares algorithms for adaptive equalization, self recovering (blind) equalization.

Spread Spectrum Signals for Digital Communication: Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals, Frequency-Hopped Spread Spectrum Signals, CDMA, time-hopping SS, Synchronization of SS systems.

Digital Communication Through Fading Multi-Path Channels: Characterization of fading multi-path channels, the effect of signal characteristics on the choice of a channel model, frequency-Nonselective, slowly fading channel, diversity techniques for fading multi-path channels, Digital signal over a frequency-selective, slowly fading channel, coded wave forms for fading channels, multiple antenna systems.

REFERENCE BOOKS:

1. John G. Proakis, "**Digital Communications**", 4th edition, McGraw Hill, 2001.
2. Stephen G. Wilson, "**Digital Modulation and Coding**," Pearson Education (Asia) Pte. Ltd, 2003.
3. Kamilo Feher, "**Wireless Digital Communications: Modulation and Spread Spectrum Applications**," Prentice-Hall of India, 2004.
4. Andrew J. Viterbi, "**CDMA: Principles of Spread Spectrum Communications,"** Prentice Hall, USA, 1995.

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10SCN22
CLIENT-SERVER PROGRAMMING

1. The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts
2. Concurrent Processing in Client-Server software: Introduction, Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design, Concurrency and Asynchronous I/O.
3. Program Interface to Protocols: Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIX I/O with TCP/IP.
4. The Socket Interface: Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in a Program, Symbolic Constants for Socket Call Parameters.
5. Algorithms and Issues in Client Software Design: Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by Name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability.
6. Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service, A UDP Client for the ECHO Service.
7. Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs Iterative Servers, Connection-Oriented Vs Connectionless Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations.
8. Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server.
9. Iterative, Connection-Oriented Servers (TCP): Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability.
10. Concurrent, Connection-Oriented Servers (TCP): Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes

TEXT BOOK:

1. Douglas E.Comer, David L. Stevens: Internetworking with TCP/IP – Vol. 3, Client-Server Programming and Applications, BSD Socket Version with ANSI C, 2nd Edition, Pearson, 2001.

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10SCE153
DATA STRUCTURES & ALGORITHMS IN C++

1. Algorithm Analysis: Mathematical Background, Model, What to Analyze, Running Time Calculations.
2. List, Stacks, and Queues: Abstract Data Types (ADTs), The List ADT, Vector and List in the STL, Implementation of Vector, Implementation of List, The Stack ADT, The Queue ADT.
3. Trees: Preliminaries, Binary Trees, The Search Tree ADT – Binary Search Trees.
4. Hashing: General Idea, Hash Function, Separate Chaining, Hash Tables Without Linked Lists, Rehashing, Hash Tables in the Standard Library.
5. Priority Queues (Heaps): Model, Simple Implementation, Binary Heap, Applications of Priority Queues, Priority Queues in the standard Library.
6. Sorting: Preliminaries, Insertion Sort, Merge sort, Quicksort.
7. Graph Algorithms: Definitions, Topological Sort, Shortest-Path Algorithms, Minimum Spanning Tree, Applications of Depth-First Search approaches.
8. Algorithm Design Techniques: Greedy Algorithms, Divide and Conquer, Dynamic Programming, Backtracking Algorithms.

TEXT BOOK:
1. Mark Allen Weiss: Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson Education, 2007

REFERENCE BOOKS:
1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
2. Sartaj Sahni: Data Structures, Algorithms and Applications in C++, 2nd Edition, Universities press, 2005.

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10ECD254
INTELLIGENT APPLICATIONS IN ELECTRICAL SYSTEMS

Sparsity oriented Programming: Introduction, physical structure and sparsity, pivoting, conservation of sparsity by optimal ordering of buses, schemes for ordering, UD table storage scheme.
Artificial Intelligence: Introduction**,** definitions, history and evolution, essential abilities of intelligence, AI applications; Problem solving: problem characteristics, problem search strategies, forward and backward reasoning, AND-OR graphs, game trees, search methods- informed and uninformed search, breadth first search and depth first search methods.
Knowledge representation: logical formalisms, propositional and predicate logic, syntax and semantics, wffs, clause form expressions, resolution- use of RRTs for proofs and answers, examples from electric power systems. Non-monotonic logic- TMS, modal, temporal and fuzzy logic.
Structured representation of knowledge: ISA/ISPART trees, semantic nets, frames and scripts, examples from electric systems.
Expert systems: Basic components, forward and backward chaining, ES features, ES development, ES categories, ES tools and examples from electric drive systems.
AI languages: LisP and ProLog - Introduction, sample segments, LisP primitives, list manipulation functions, function predicates, variables, iteration and recursion, property lists, sample programs for examples from electric power systems.

REFERENCE BOOKS:

1. D.W.Patterson, ``Introduction to Artificial Intelligence and Expert Systems'', Prentice-Hall of India, 1992.
2. J.Vlach and Singhal, ``Computer Methods for Circuit Analysis and Design'', CBS Publishers, 1986.
3. Rich, Elaine, Kevin Knight, ``Artificial Intelligence'', Tata McGraw-Hill, 1991.
4. Charniak E. and Mcdermott D., ``Introduction to AI'', Addison-Wesley, 1985.
5. Nils J.Nilson, ``Problem Solving Methods in AI'', McGraw-Hill, 1971.
6. Nils J.Nilson, ``Principles of AI'', Berlin Springer-Verlag, 1980.

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10SCE323
ADVANCES IN DIGITAL SIGNAL PROCESSING

1. Introduction and Review: Basic concepts of Digital Signal Processing, Basic digital signal processing examples in block diagram, Overview of typical Digital Signal Processing in real-world applications.
2. Sampling and Reconstruction of Signals: Sampling band-pass signals, Analog-to-digital and digital-to-analog conversions.
3. Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Filter design and implementation for sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band-pass signals, Sampling rate conversion by an arbitrary factor, Applications of multirate signal processing.
4. Linear Prediction and Optimum Linear Filters: Representation of a random process, Forward and backward linear prediction, Solution of normal equations, Properties of the linear error-prediction filters, AR lattice and ARMA lattice-ladder filters, Wiener filters for filtering and prediction.
5. Power Spectrum Estimation: Estimation of spectra from finite-duration observations of signals, Non-parametric methods for power spectrum estimation, Parametric methods for Power Spectrum Estimation, Minimum variance spectral estimation, Eigenanalysis algorithm for spectral estimation.
6. Hardware and Software for Digital Signal Processors: Digital signal processor architecture, Digital signal processor hardware units, Fixed-point and floating-point formats.

TEXT BOOKS:
1. John G. Proakis and Dimitris G. Manolakis: Digital Signal Processing, 3rd Edition, Pearson, 2003.
2. Li Tan: Digital Signal Processing – Fundamentals and applications, Elsevier, 2008.

REFERENCE BOOKS:
1. Paulo S. R. Diniz, Eduardo A. B. da Silva And Sergio L. Netto: Digital Signal Processing: System Analysis and Design, Cambridge University Press, 2002.
2. Sanjit K. Mitra: Digital Signal Processing, A Computer Based Approach, Tata McGraw Hill, 2001.
3. Alan V.Oppenheim and Ronald W.Schafer: Digital Signal Processing, PHI Learning, 2003.

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10SSE151
ADVANCES IN COMPILER DESIGN

1. Introduction and Review: Language processors; The structure of a Compiler; The evolution of programming languages; The science of building a compiler; Applications of Compiler technology; Programming language basics.
2. Topics in Code Generation: Issues in the design of Code Generator; Peephole optimization; Register allocation and assignment; Instruction selection by tree rewriting; Optimal code generation for expressions; Dynamic programming code generation.
3. Machine-Independent Optimizations: The principle sources of optimization; Introduction to data flow analysis; Foundations of data flow analysis; Constant propagation; Partial-redundancy elimination; Loops in flow graphs; Region-based analysis; Symbolic analysis.
4. Instruction-Level Parallelism: Process architectures; Code-scheduling constraints; Basic-block scheduling; Global code scheduling; Software pipelining.
5. Optimizing for Parallelism and Locality: Basic concepts; An example of matrix multiplication; Iteration spaces; Affine array indexes; Data reuse; Array data – dependence analysis; Finding synchronization-free parallelism; Synchronization between parallel loops; Pipelining; Locality optimizations.

TEXT BOOKS:
1. Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman: Compilers - Principles, Techniques and Tools, 2nd Edition, Pearson, 2007.

REFERENCE BOOKS:
1. Charles N. Fischer, Richard J. leBlanc, Jr.: Crafting a Compiler with C, Pearson, 1991.
2. Andrew W Apple: Modern Compiler Implementation in C, Cambridge University Press, 1997.
3. Kenneth C Louden: Compiler Construction Principles & Practice, Cengage Learning, 1997.

10SCN12
COMPUTER NETWORKS

1. Review of Basic Concepts: Building a Network; Applications; Requirements; Network Architecture; Implementing Network software; Performance; Physically connecting hosts; Hardware building blocks.
2. Packet Switching: Switching and forwarding; Bridges and LAN Switches; Cell Switching; Implementation and Performance.
3. Internetworking: Simple internetworking (IP); Routing; Global Internet; Multicast; MPLS
4. End –to-End Protocols: Simple demultiplexer (UDP); Reliable byte stream (TCP); RPC; RTP.
5. Congestion Control and Resource Allocation: Issues in resource allocation; Queuing discipline; TCP Congestion Control; Congestion-Avoidance mechanisms; Quality of Service.
6. Applications: Traditional applications; Web services; Multimedia applications; Overlay Networks.

TEXT BOOK:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 4th Edition, Elsevier, 2007.

REFERENCE BOOKS:

1. Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata McGraw Hill, 2006.
2. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2007.
3. Alberto Leon-Garcia and Indra Widjaja: Communication Networks -Fundamental Concepts and Key Architectures, 2nd Edition Tata McGraw-Hill, 2004.

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10SSE11
TOPICS IN SOFTWARE ENGINEERING – I

1. Introduction and Review of Software Process Models
FAQs about Software Engineering; Professional and ethical responsibility;Software process models; Process iteration; Process activities; Computer-Aided Software Engineering.
2. Rapid Software Development, Software Reuse
Agile methods; Extreme programming; Rapid application development. Reuse landscape; Design patterns; Generator-based reuse; Application frameworks; Application system reuse.
3. CBSE
Components and component models; Component-Based Software Engineering (CBSE).
4. Software Evolution: Program evolution dynamics; Software maintenance; Evolution processes; Legacy system evolution.
5. Verification and Validation
Planning verification and validation; Software inspections; System testing; Component testing; Test case design; Test automation.
6. Critical Systems, Specifications of Critical Systems
What are critical systems? Examples; System dependability, availability and reliability. Risk-driven specification; Safety specification; Security specification; Software reliability specification.
7. Critical Systems Development, Validation
Dependable processes; Dependable programming; Fault tolerance and fault tolerant architectures.
Reliability validation; Safety assurance; Security assessment; Safety and dependability cases.
8. Distributed Systems Architecture
Multiprocessor architectures; Client-Server architectures; Distributed object architectures; Inter-Organizational distributed computing.
9. Real-Time Software Design
Real-time systems; System design; Monitoring and control systems; Data
acquisition systems.

TEXT BOOK:
1. Ian Sommerville: Software Engineering, 8th Edition, Pearson Education, 2007.

REFERENCE BOOKS:
1. Roger.S.Pressman: Software Engineering-A Practitioners approach, 7th Edition, McGraw-Hill, 2007.

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10EC131
WIRELESS AND MOBILE NETWORKS

Review of fundamentals of wireless communication and networks. Wireless communication channel specifications, wireless communication systems, wireless networks, switching technology, communication problems, wireless network issues and standards.

Wireless body area networks (WBAN). Properties, network architecture, components, technologies, design issues, protocols and applications.

Wireless personal area networks. Architecture, components, requirements, technologies and protocols, Bluetooth and Zigbee.

Wireless LANS. Network components, design requirements, architectures, IEEE 802.11x, WLAN protocols, 802.11 p and applications.

WMANs. IEEE 802.16, architectures, components, WiMax mobility support, protocols, broadband networks and applications. WWANs. Cellular networks, Satellite networks, applications.

Wireless adhoc networks. Mobile adhoc networks, Sensor networks, Mesh networks, VANETs. Research issues in wireless networks.

REFERENCE BOOKS:

1. S. S. Manvi, M. S. Kakkasageri, "**Wireles and Mobile Network concepts and protocols**", Wiley, First edition, 2010.
2. P. Kaveh, Krishnamurthy, "**Principles of wireless networks: Aunified approach**", PHI, 2006.
3. Iti Saha Mishra, "**Wireless communication and networks 3G and beyond** ", MGH, 2009.
4. Mullet, "**Introduction to wireless telecommunication systems and networks**", Cengage, 2009.
5. D. P. Agarwal, Qing An Zeng, "**Introduction to wireless and mobile systems**", Cengage, 2008.
6. Ivan Stojmenovic, "**Handbook of wireless networks and mobile computing**", Wiley, 2009.

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10EC023
CRYPTOGRAPHY AND NETWORK SECURITY

Overview: *Services, Mechanisms and attacks, OSI security architecture, Model for network security.*

Classical Encryption Techniques: *Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography, Problems.*

Block Ciphers and DES (Data Encryption Standards): Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems.

Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Problems.

Other Public Key Crypto Systems and Key Management: Key management, Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems.

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Problems.

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard.

Authentication Applications: Kerberos, X.509 authentication service, Kerberos encryption technique, Problems.

Electronic Mail Security: Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64 conversion, PGP random number generator.

IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security pay load), Security associations, Key management, Problems.)

Firewalls: Firewall design principles; Trusted systems, Problems.

REFERENCE BOOKS:

1. William Stallings, "**Cryptography and Network Security**," 3rd edition, Pearson Education (Asia) Pte. Ltd./ Prentice Hall of India, 2003.
2. C. Kaufman, R. Perlman, and M. Speciner, "**Network Security: Private Communication in a Public World**", 2nd edition, Pearson Education (Asia) Pte. Ltd., 2002.
3. Atul Kahate, "**Cryptography and Network Security**", Tata McGraw-Hill, 2003.
4. Eric Maiwald, "**Fundamentals of Network Security**", McGraw-Hill, 2003.

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10EPE253

ELECTROMAGNETIC COMPATIBILITY

Review of EMI Theory, Sources of EMI, Noise pick up modes and reduction techniques for analog circuits; Use of co-axial cables and shielding of signal lines; Conducted and radiated noise emission in power electronic equipment and reduction techniques; EMI induced failure mechanisms for power electronic equipment; EMC in design of digital circuits; ESD and switching interference reduction; Susceptibility aspects of power electronic and digital equipment; Shielding of electronic equipment; EMC standards and test equipment.

REFERENCE BOOKS:

1. Otto H. W., "**Noise Reduction Techniques in Electronic Systems**", 2nd Edition, 1985.
2. William B. Greason, "**Electrostatic Damage in Electronics: Devices and Systems**", John Wiley and Sons, 1986.
3. Joseph Di Giacomo, **"Digital Bus Hand Book**", McGraw Hill Publishing Company, 1990.
4. White, R. J. "**Handbook series of Electromagnetic Interference and Compatibility**", Don White consultants Inc. 1980.

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10LBI251

THEORY & DESIGN OF BIO-MEDICAL INSTRUMENTS

Analytical methods, Passive Transducers

Piezoelectric Transducer

Ultrasonic instruments, Electrodynamic & Magnestrictive transducers

Force balance transducers, Fiber optic transducers

Signal processing Circuitry & Microprocessors

Biotelemetry

Frequency discriminators & Phase locked loops

TEXT BOOK:

1. Walter Welkowitz and others, " **Biomedical Instruments- Theory and Design**" Academic Press 1992,II edition

REFERENCE BOOKS:

1. R.S, C. Cobbold, "**Transducers for biomedical measurements: Principle and practice**", John Wiley 1974
2. Tatsno Togawa, Toshiyo Tarnura, P.Akeoberg " **Biomedical transducers and Instruments**" CRC press 1997

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10EC005
ADVANCED CONTROL SYSTEMS

Digital Control Systems: Review of difference equations and Z — transforms, Z- transfer function (Pulse transfer function), Z.-. Transforms analysis sampled data systems, Stability analysis (Jury's Stability Test and Bilinear Transformation), Pulse transfer functions and different configurations for closed loop Discrete-time control systems

Modern Control Theory: I, State model for continuous time and discrete time systems, Solutions of state equations (for both continuous and discrete systems), Concepts of controllability and observability (For both continuous and discrete systems), Pole Placement by state feedback (for both continuous and discrete systems), Full order and reduced order observes (for both continuous and discrete systems), Dead beat control by state feedback, Optimal control problems using state variable approach, State Regulator and output regulator, Concepts of Model reference control systems, Adaptive Control systems and design

Non Linear Control Systems: Common nonlinearities, Singular Points, Stability of nonlinear systems - Phase plane analysis and describing function analysis, Liapunoy's stability criterion, Popov's criterion

REFERENCE BOOKS:

1. Ogata. K. "**Modern Control Engineering**", PHI.
2. Ogata K "**Discrete time Control Systems**", Pearson Education.
3. Nagarath and Gopal, "**Control Systems Engineering**", Wiley Eastern Ltd.
4. M Gopal "**Modem Control System Theory**"; Wiley Eastern Ltd.
5. M. Gopal, "**Digital Control & State Variable Methods**", TMH, 2003.

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10EC010
ALGORITHMS FOR VLSI DESIGN AUTOMATION

Logic Synthesis & Verification: Introduction to combinational logic synthesis, Binary Decision Diagram, Hardware models for High-level synthesis.

VLSI Automation Algorithms:
Partitioning: problem formulation, classification of partitioning algorithms, Group migration algorithms, simulated annealing & evolution, other partitioning algorithms

Placement, Floor Planning & Pin Assignment: problem formulation, simulation base placement algorithms, other placement algorithms, constraint based floor planning, floor planning algorithms for mixed block & cell design. General & channel pin assignment
Global Routing: Problem formulation, classification of global routing algorithms, Maze routing algorithm, line probe algorithm, Steiner Tree based algorithms, ILP based approaches

Detailed Routing: problem formulation, classification of routing algorithms, single layer routing algorithms, two layer channel routing algorithms, three layer channel routing algorithms, and switchbox routing algorithms

Over the Cell Routing & Via Minimization: two layers over the cell routers, constrained & unconstrained via minimization

Compaction: problem formulation, one-dimensional compaction, two dimension based compaction, hierarchical compaction

REFERENCE BOOKS:

1. Naveed Shervani, "**Algorithms for VLSI Physical Design Automation**", Kluwer Academic Publisher, Second edition.
2. Christophn Meinel & Thorsten Theobold, "**Algorithm and Data Structures for VLSI Design**", KAP, 2002.
3. Rolf Drechsheler : "**Evolutionary Algorithm for VLSI**", Second edition.
4. Trimburger, "**Introduction to CAD for VLSI**", Kluwer Academic publisher, 2002.

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10EC011
ANTENNA THEORY & DESIGN

Antenna Fundamentals and Definitions: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Radiation Patterns, Directivity and Gain, Antenna Impedance, Radiation Efficiency. Antenna Polarization

Resonant Antennas: Wires and Patches, Dipole ntennas, Yagi - Uda Antennas, Micro strip Antenna.

Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques, perspective on arrays.

Broad band Antennas: Traveling - wave antennas, Helical antennas, Biconical antennas, sleave antennas, and Principles of frequency - independent Antennas, spiral antennas, and Log - Periodic Antennas.

Aperture Antennas: Techniques for evaluating Gain, reflector antennas - Parabolic reflector antenna principles, Axi -symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model, feed antennas used in practice.

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier Series, Woodward — Lawson sampling method, comparison of shaped beam synthesis methods, low side lobe narrow main beam synthesis methods Dolph Chebyshev linear array, Taylor line source method.
]
Method of Moments : Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of antenna and scatter characteristics.

CEM for Antennas : Finite Difference Time Domain Method Geometrical Optics Wedge diffraction theory, ray fixed coordinate system, uniform theory of wedge diffraction, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot on a finite ground plane, radiation by a monopole on a finite ground plane, equivalent current concepts, multiple diffraction formulation, by curved surfaces, physical optics, method of stationary phase, physical theory of diffraction, cylindrical parabolic reflector antennas.

REFERENCE BOOKS:

1. C. A. Balanis: "**Antenna Theory Analysis and Design"**, John Wiley, 2nd Edition, 1997.
2. Kraus: "**Antennas"**, McGraw Hill, TMH, 3rd/4th Edition..
3. Stutzman and Thiele, "**Antenna Theory and Design**", 2nd Ed, John Wiley and Sons Inc..
4. Sachidananda et. el, "**Antenna and Propagation"**, Pearson Edu.

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10EC017
BIO-MEDICAL SIGNAL PROCESSING

Introduction: Genesis and significance of bioelectric potentials, ECG, EOG, EMG and their monitoring and measurement,
Spectral analysis, digital and analog filtering, correlation and estimation techniques, AR / ARMA models, Adaptive Filters,

ECG: Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Baseline wander removal, wave form recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

EEG: evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages,

EMG: wave pattern studies, biofeedback, Zero crossings, Integrated EMG. Time frequency methods and Wavelets in Biomedical Signal Processing

REFERENCE BOOKS:

1. Willis J Tompkins, ED. "**Biomedical Digital Signal Processing**", Prentice-Hall of India, 1996.
2. R E Chellis and R I Kitney, "**Biomedical Signal Processing**", in IV parts, Medical and Biological Engg. And current computing, 1990-91.
3. Special issue on Biological Signal Processing, Proc. IEEE 1972
4. Arnon Kohen, "**Biomedical Signal Processing**", Volumes I & II, CRC Press.
5. Metin Aray, "**Time frequency and Wavelets in Biomedical Signal Processing",** IEEE Press, 1999. Current Published literature.

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10EC027
DESIGN OF VLSI SYSTEMS

VLSI System Design Methodology: Structure Design, Strategy, Hierarchy, Regularity, Modularity, and Locality. System on Chip Design options: Programmable logic and structures, Programmable interconnect, programmable gate arrays, Sea of gate and gate array design, standard cell design, full custom mask design.

Chip Design Methods: Behavioral synthesis, RTL synthesis, Logic optimization and structural tools layout synthesis, layout synthesis, EDA Tools for System

Design Capture Tools: HDL Design, Schematic Design, Layout Design, Floor planning and Chip Composition. Design Verification Tools: Simulation Timing Verifiers, Net List Comparison Layout Extraction, Design Rule Verification.

Data Path Sub System Design: Introduction, Addition, Subtraction, Comparators, Counters, Boolean logical operations, coding, shifters, Multiplication, Parallel Prefix computations

Array Subsystem Design: SRAM, Special purpose RAMs, DRAM, Read only memory, Content Addressable memory, Programmable logic arrays.

Control Unit Design: Finite State Machine (FSM) Design, Control Logic Implementation: PLA control implementation, ROM control implementation.

Special Purpose Subsystems: Packaging, power distribution, I/O, Clock, Transconductance amplifier, follower integrated circuits, etc

Design Economics: Nonrecurring and recurring engineering Costs, Fixed Costs, Schedule, Person power, example

VLSI System Testing & Verification: Introduction, A walk through the Test Process, Reliability, Logic Verification Principles, Silicon Debug Principles, Manufacturing Test Principles, Design for Testability, Boundary Scan

VLSI Applications: Case Study: RISC microcontroller, ATM Switch, etc.

REFERENCE BOOKS:

1. Neil H.E. Weste, Davir Harris, "**CMOS VLSI Design: A Circuits and System Perspectives**" Addison Wesley - Pearson Education, 3rd Edition, 2004.
2. Wayne, Wolf, "**Modern VLSI Design: System on Silicon**" Prentice Hall PTR/Pearson Education, Second Edition, 1998
3. Douglas A Pucknell & Kamran Eshragian , "**Basic VLSI Design**" PHI 3rd Edition (original Edition – 1994)

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10EC029
DIGITAL CIRCUITS AND LOGIC DESIGN

Threshold Logic: Introductory Concepts, Synthesis of Threshold Networks.

Reliable Design and Fault Diagnosis Hazards: Fault Detection in Combinational Circuits, Fault-Location Experiments, Boolean Differences, Fault Detection by Path Sensitizing, Detection of Multiple Faults, Failure-Tolerant Design, Quadded Logic

Capabilities, Minimization, and Transformation of Sequential Machines: The Finite- State Model, Further Definitions, Capabilities and Limitations of Finite – State Machines, State Equivalence and Machine Minimization, Simplification of Incompletely Specified Machines.

Structure of Sequential Machines: Introductory Example, State Assignments Using Partitions, The Lattice of closed Partitions, Reductions of the Output Dependency, Input Independence and Autonomous Clocks, Covers and Generation of closed Partitions by state splitting, Information Flow in Sequential Machines, Decompositions, Synthesis of Multiple Machines.

State—Identifications and Fault-Detection Experiments: Homing Experiments, Distinguishing Experiments, Machine Identification, Fault-Detection Experiments, Design of Diagnosable Machines, Second Algorithm for the Design of Fault Detection Experiments, Fault-Detection Experiments for Machines which have no Distinguishing Sequences.

REFERENCE BOOKS:

1. Zvi Kohavi, "**Switching and Finite Automata Theory**", 2nd Edition. Tata McGraw Hill Edition.
2. Charles Roth Jr., "**Digital Circuits and Logic Design**"
3. Parag K Lala, "**Fault Tolerant And Fault Testable Hardware Design**", Prentice Hall Inc. 1985.
4. E. V. Krishnamurthy, "**Introductory Theory Of Computer**", Macmillan Press Ltd, 1983.
5. Mishra & Chandrasekaran, "**Theory Of Computer Science –** Automata, Languages And Computation", 2nd Edition, PHI,2004.

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10EC030
DIGITAL SIGNAL COMPRESSION

Introduction: Compression techniques, Modeling & coding, Distortion criteria, Differential Entropy, Rate Distortion Theory, Vector Spaces, Information theory, Models for sources, Coding – uniquely decodable codes, Prefix codes, Kraft McMillan Inequality
Quantization: Quantization problem, Uniform Quantizer, Adaptive Quantization, Non-uniform Quantization; Entropy coded Quantization, Vector Quantization, LBG algorithm, Tree structured VQ, Structured VQ, Variations of VQ – Gain shape VQ, Mean removed VQ, Classified VQ, Multistage VQ, Adaptive VQ, Trellis coded quantization
Differential Encoding: Basic algorithm, Prediction in DPCM, Adaptive DPCM, Delta Modulation, Speech coding – G.726, Image coding.

Transform Coding: Transforms – KLT, DCT, DST, DWHT; Quantization and coding of transform coefficients, Application to Image compression – JPEG, Application to audio compression.

Sub-band Coding: Filters, Sub-band coding algorithm, Design of filter banks, Perfect reconstruction using two channel filter banks, M-band QMF filter banks, Poly-phase decomposition, Bit allocation, Speech coding – G.722, Audio coding – MPEG audio, Image compression.

Wavelet Based Compression: Wavelets, Multiresolution analysis & scaling function, Implementation using filters, Image compression – EZW, SPIHT, JPEG 2000.

Analysis/Synthesis Schemes: Speech compression – LPC-10, CELP, MELP, Image Compression – Fractal compression.
Video Compression: Motion compensation, Video signal representation, Algorithms for video conferencing & videophones – H.261, H. 263, Asymmetric applications – MPEG 1, MPEG 2, MPEG 4, MPEG 7, Packet video.

Lossless Coding: Huffman coding, Adaptive Huffman coding, Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding, Arithmetic coding, Algorithm implementation, Applications of Arithmetic coding, Dictionary techniques – LZ77, LZ78, Applications of LZ78 – JBIG, JBIG2, Predictive coding – Prediction with partial match, Burrows Wheeler Transform, Applications – CALIC, JPEG-LS, Facsimile coding – T.4, T.6.

REFERENCE BOOKS:
1. K. Sayood**,** "**Introduction to Data Compression"**, Harcourt India Pvt. Ltd. & Morgan Kaufmann Publishers, 1996.
2. N. Jayant and P. Noll, "**Digital Coding of Waveforms: Principles and Applications to Speech and Video"**, Prentice Hall, USA, 1984.
3. D. Salomon," **Data Compression: The Complete Reference**", Springer, 2000.
4. Z. Li and M.S. Drew**,** "**Fundamentals of Multimedia**", Pearson Education (Asia) Pte. Ltd., 2004.

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10EC033
DISTRIBUTED COMPUTING

Fundamentals of Distributed Computing: Architectural models for distributed and mobile computing systems, Basic concepts in distributed computing such as clocks, message ordering, consistent global states, and consensus.

Basic Algorithms in Message: Passing Systems, Leader Election in Rings, and Mutual Exclusion in Shared Memory, Fault-Tolerant Consensus, Causality and Time. Message Passing: PVM and MPI.

Distributed Operating Systems: OS and network operating systems, Distributed File systems, Middleware, client/server model for computing, common layer application protocols (RPC, RMI, and streams), distributed processes, network naming, distributed synchronization and distributed object-based systems

Distributed File Systems: Features of DFS, File Models, File Accessing Models, File-Sharing Semantics, File-Caching Schemes, File Replication, NFS, AFS Architecture.

Distributed Shared Memory: General Architecture of DSM Systems, Design and Implementation Issues of DSM, Consistency Models, Replacement Strategy, Thrashing.

Distributed Environments: Current systems and developments (DCE, CORBA, and JAVA).

REFERENCE BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "**Distributed Systems: Concepts and Design**" Third Edition Addison-Wesley, Pearson Education, 2001.
2. Distributed Operating Systems: "**Concepts and Design",** Pradeep K. Sinha, PHI, 2002.
3. Tannenbaum, "**A. Distributed Operating Systems**", Prentice Hall 1995.

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10EC046
LINEAR ALGEBRA

Linear equations: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization.

Vector Spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces.
Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functionals; transpose of a linear transformation.

Canonical Forms: Characteristic values; annihilating polynomials; invariant subspaces; direct-sum decompositions; invariant direct sums; primary decomposition theorem; cyclic bases; Jordan canonical form. Iterative estimates of characteristic values.
Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; unitary operators.

Symmetric Matrices and Quadratic Forms: Digitalization; quadratic forms; constrained optimization; singular value decomposition.

REFERENCE BOOKS:

1. Gilbert Strang**,** "**Linear Algebra and its Applications**", 3rd edition, Thomson Learning Asia, 2003.
2. Kenneth Hoffman and Ray Kunze, "**Linear Algebra**," 2nd edition, Pearson Education (Asia) Pte. Ltd/ Prentice Hall of India, 2004.
3. David C. Lay, "**Linear Algebra and its Applications**," 3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.
4. Bernard Kolman and David R. Hill, "**Introductory Linear Algebra with Applications**," Pearson Education (Asia) Pte. Ltd, 7th edition, 2003.

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10EC057
NETWORK PROTOCOL DESIGN

Introduction: How to specify network protocols? Semantics of traditional protocol specifications, syntax of traditional protocol specifications new protocol specifications first protocol examples a vending machine protocol a request/reply protocol a Manchester encoding protocol the current internet network processes constants, inputs, and variables actions protocol execution processes in the internet more on processes messages with fields nondeterministic assignment process arrays parameters a resource allocation protocol process communication in the internet

Transmission and Error: types of transmission errors protocol execution under error occurrence protocols that tolerate error occurrence normal timeout actions implementing normal timeout actions transmission errors in the internet connections using timeouts connections using identifiers full-duplex and half-duplex connections, connections in the internet data transfer and multiplexing data with idleness multiplexing data with control multiplexing data with data, data transfer and multiplexing in the internet error detection, detection of message corruption detection of message loss detection of message reorder error detection in the internet error recovery forward error recovery backward error recovery cumulative acknowledgment individual acknowledgment block acknowledgment error recovery in the internet flow control window size control rate control circular buffer control flow control in the internet maintaining topology information local and global topology information maintaining local topology information maintaining hierarchical topology information maintaining topology information in the internet the abstraction of perfect channel using the abstraction of perfect channel the abstraction of perfect channel in the internet

Routing and Switching: hierarchical routing random routing detection of message reorder error detection in the internet circuit switching datagram switching , switching in networks with changing topologies switching in the internet congestion control congestion control in circuit networks congestion control in datagram networks deadlock prevention in datagram networks congestion control in the internet the abstraction of virtual neighborhood the abstraction of virtual neighborhood in the internet using the abstraction of virtual neighborhood naming and name resolution hierarchical names name resolution name caches naming and name resolution in the internet

Security and Applications: Asymmetric and symmetric keys, authentication using asymmetric keys, authentication using symmetric keys . Privacy and integrity, non-repudiation authorization message digest .Security in the internet, data compression. Huffman coding, Static Huffman compression, Dynamic Huffman compression. Context-sensitive compression, lossy compression data compression in the internet .Broadcast and multicast maintaining spanning trees, low-level broadcast, high -level broadcast, ordered precedence, and recall broadcasts. Hierarchy of broadcast primitives broadcast and multicast in the internet.

REFERENCE BOOKS:

1. Mohamed G. Gouda, "**Elements of Network Protocol Design**", John Wiley & Sons 2004.
2. Douglas E Comer, "Computer Networks and Internet with Internet Applications", Fourth Edition, Pearson 2004.

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10EC132
WIRELESS SENSOR NETWORKS

Fundamental Properties and Links: -

Information-theoretic Bounds on Sensor Networks Performance: Introduction, Sensor Network Models, Digital Architecture, The price of Digital Architectures, Bounds on General Architecture.

In-Network Information Processing in Wireless Sensor Networks: Introduction, Communication Complexity Model, Comparing Functions over Wireless Networks; Special Reuse and Block Computation, Wireless
Networks with Noise Communications; Reliable Computation in a Collocated Broadcast Network, Towards an Information Theoretic Formulation.

The Sensing Capacity of Sensor Networks: Introduction, Sencing Capacity of Sensor Networks, Extensions to Other Sensor Network Models.

Law of Sensor Network Lifetime and Its Applications: Introduction, Low of Network Lifetime and General Design Principles, Fundamental Performance Limit: A Stochastic Shortest Path Framework, Distributes Asymptotically Optimal Transmission Scheduling, A Brief Overview of Network Lifetime Analysis.

Signal Processing for Sensor Networks: -

Detection in Sensor Networks: Centralized Detection, Decentralized Detection in Wireless Sensor Networks, Wireless Sensor Networks, New Paradigms, Extension and Generalization.

Distributed Estimation under Bandwidth and Energy Constrains: Distributed Quantization Estimation, Maximum Likelihood Estimation, Unknown Noise pdf, Estimation of Vector Parameters, Maximum a Posterior Probability Estimation, Dimensionality Reduction for Distributed Estimation, Distortion-Rate Analysis.

Distributed Learning in Wireless Sensor Networks: Introduction, Classical Learning, Distributed Learning in Wireless Sensor Networks, Distributed Learning in WSNs with a Fusion Center, Distributed Learning in Ad-hoc WSNs with In-network Processing.

Graphical Models and Fusion Sensor Networks: Introduction, Graphical Models, From Sensor Network Fusion to Graphical Models, Message Censoring, Approximation and Impact on Fusion, The effects of Message Approximation, Optimizing the Use of Constrained Resources in Network Fusion.

Communication, Networking and Cross-Layered: -

Randomized Cooperative Transmission in Large-Scale Sensor Networks: Introduction, Transmit Co-operation in Sensor Networks, Randomized Distributed Co-operative Codes, Performance of Randomized Cooperation Codes, Analysis of Cooperative Large –scale Networks Utilizing Randomized Cooperative Codes.

Application Dependent Shortest Path Routing in Ad-hoc Sensor Networks: Introduction, Fundamental SPR, SPR for Mobile Wireless Network, SPR for Ad-hoc Sensor Networks.

Data-Center and Cooperative MAC Protocols for Sensor Networks: Introduction, Traditional Medium Access Control Protocols: Random Access and Deterministic Scheduling, Energy-Efficient MAC Protocols for Sensor Networks, Date-Centric MAC Protocols for Sensor Networks, Cooperative MAC Protocol for Independent Sensors, Cooperative MAC Protocol for Correlated Sensors.

Game Theoretic Activation and Transmission Scheduling in Unattended Ground Sensor Networks: A Correlated Equilibrium Approach; Introduction, Unattended Ground Sensor Network, Sensor Activation as Correlated Equilibrium, Energy-Efficient Transmission Scheduling, Numerical Results.

REFERENCE BOOK:

1. Ananthram Swami et. el," **Wireless Sensor Networks: Signal Processing and Communication Perspectives",** John Wiley, 2007.

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10EC054
NANOELECTRONICS

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), Resonant Tunneling Transistors, Single electron transistors, new storage, optoelectronic, and spintronics devices.

Atoms-up approaches: Molecular electronics involving single molecules as electronic devices, transport in molecular structures, molecular systems as alternatives to conventional electronics, molecular interconnects; Carbon nanotube electronics, band structure & transport, devices, applications.

REFERENCE BOOKS:

1. C.P. Poole Jr., F.J. Owens, "**Introduction To Nanotechnology**", Wiley (2003).
2. **Waser Ranier, "Nanoelectronics and Information Technology**" (Advanced Electronic Materials and Novel Devices), Wiley-VCH (2003).
3. K.E. Drexler, "**Nano Systems**", Wiley (1992).
4. John H. Davies, "**The Physics of Low-Dimensional** Semiconductors", Cambridge University Press, 1998 Research papers.

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Group II

10EEM151
COMPUTER MODELING OF ELECTRICAL POWER SYSTEM

Introduction to Modeling of Power Transmission Plant: Introduction. Linear transformation techniques. Basic single phase modeling. Three phase system analysis. Three phase models of transmission lines and transformers. Formation of the system admittance matrix.

Modeling of Static AC-DC Conversion Plant: Introduction. Rectification, inversion. Commutation reactance. DC transmission.

Load Flow: Introduction, Basic nodal-method. Conditioning of Y matrix when one voltage is known. Analytical definition of the problem. Newton-Raphson method of solving load flow problem. Techniques that make Newton-Raphson Method competitive in load flow. Characteristics of the Newton-Raphson load flow method. Decoupled Newton load flow method. Fast Decoupled load flow. Convergence criteria and tests. Numerical examples.

AC-DC Load Flow: Introduction. Formulation of the problem. DC system model. Solution techniques. Control of converter AC terminal voltage. Extension to multiple and or multi-terminal DC systems. DC convergence tolerance. Test system and results, Numerical examples.

REFERENCE BOOKS:

1. J.Arrillaga and C.P.Arnold and B.J.harker, "**Computer Modeling of Electrical Power Systems**", Wiley Inter-science Publications, John Wiley & Sons(Text Book).
2. E.Clarke-"**Circuit Analysis of AC Power Systems**", Vol.I John Wiley & Sons Ltd, New York.
3. Glenn W.Stagg and E.L.Abiad, "**Computer Methods in Power System Analysis**", McGraw Hill Publishers.
4. E.W.Kimbark "**Direct Current Transmission**", Vol.1, Wiley Inter-Science, London

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10EEM152
SWITCHED MODE POWER CONVERSION

DC-DC Converters (Basic Converters): Principle of operation and analysis of Buck, Boost, and Buck-Boost converter for continuous and discontinuous current mode.

Derived Converters: Principle of operation and analysis of forward, Flyback, Pushpull, Half bridge, Full bridge converters, cuk converters.

Control of DC-DC Converter: Modelling of DC-DC Converters using state space averaging, current mode control.

Resonant Converters: Introduction, classification, Basic Resonant circuit concepts, Resonant switch converters, Zero voltage switching, clamped voltage topologies, Resonant DC buck converters.

REFERENCE BOOKS:

1. Ned Mohan, Tore.M. Undeland and William.P Robbins, "**Power Electronics Converters"**, applications and design", John Wiley 2003.
2. Rashid M.H. Power Electronics – "**Circuits Devices and Applications**", Prentice Hall India Third Edition.

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10EEM322

BIO-MASS ENERGY RESOURCES

Introduction: Bio-energy,Photo-synthesis and fuel production in a nutshell.

Solar Energy and Photo-Synthesis: Solar energy-down to earth. Mechanisms of photo synthesis.

Energy from Bio-masses: Bio-gas generation. Factors affecting bio-digestion or generation of gas. Types of bio-gas plants. Constructional details of some main digesters. Bio-gas from plant wastes. Digester design considerations. Methods for maintaining bio-gas production. Problems related to bio-gas plant.

The Bio-energy Conversion Technology: An overview. Anaerobic digestion. Alcoholic fermentation. Chemical reduction. Gasification. Pyrolysis. Direct combustion.

The Economics of Bio-mass Systems: General considerations. Net present value. Energy payback time. Some conventional economic costing. Costs of bio-mass fuels Relative prices of biological and other fuels.

Present Developments and Future Prospects: The state of the art – an over view. Hydrogen and electricity via bio-photolysis – hope for the future. Petrol pump plants. Improving plant productivity I and II. Conservation through integration – a system approach. Bio-mass potential for national energy autonomy. The biological path to self-reliance.

REFERENCE BOOKS:

1. Malcolm Slesser and Chris Lewis, "**Biological Energy Resource".**
2. G.D.Roy, "**Renewable Energy Sources**".
3. K.R.Datye, "**Banking on Bio-mass**".
4. Edward A Hiler and Bill A Stout, "**Bio-mass Energy: A Monograph**".

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10EEM153
ENGINEERING ECONOMICS AND MANAGEMENT

Interest and Time Value of Money: Simple interest. Compound interest. Single payments. Uniform series payments. Interest factors and tables. Nominal and effective interest rates. Continuous compounding. Uniform continuous payments.

Methods for Evaluation of Tangible Alternatives: Present worth comparison. Equal, unequal live assets. Study period. Capitalized cost. Bond valuation. Equivalent uniforms annual cost comparison. Rate of return comparison.

Replacement Analysis: Review of conventional approach. Analysis with time value accounting. Current salvage value of the defender. Defender and challenger with different lives. Additional one year assessment. Review of project management – PERT and CPM Crashing cost system.

Project Feasibility Analysis: Case study: Report preparation. Depreciation reasons,depreciation accounts. Causes of declining value. Depreciation methods. Costs volume profit analysis. Review of conventional approach. Analysis with time value, linear, nonlinear multi product analysis.

Marketing Feasibility: Types of market identification of investment opportunities. Market and demand analysis. Forecasting demand(review). Forecast control. Secondary sources of information.

Technical Feasibility: Product design and development. Concept of concurrent engineering. Plant design and capacity planning. Equipment selection. Process planning. Line balancing. Purchasing, Make versus buy decisions. Productivity analysis.

Financial feasibility: Means of financing. Financial institutions – all India and state level. Profitability. Cash flows of a project. Financial leverage of a business. Tax factors in investment analysis. Direct, indirect, advance tax. Tax rates. Incentives for new industries in backward areas.

Risk Analysis and Decision Trees: Recognizing risk, including risk in economic analysis. Expected value. Payoff table. Decision trees, Discounted decision trees. Present economic policy. Liberalization, Privatization, Globalization, Scope for industrial growth.

REFERENCE BOOKS:

1. James.L.Riggs – "**Essentials of Engineering Economics**", Mcgraw Hill Book Company, 1982.
2. Prasanna Chandra, "**Project Preparation, Appraisal and Implementation"**, Tata McGraw Hill, New Delhi, 1992(Text book).
3. Norman.N.Barish, "**Economics Analysis for Engineering and Managerial Decision Making**", McGraw hill Book Company, 1983.
4. Leland.T.Blank, Anthony.J.Jarquin, "**Engineering Economy**", McGraw Hill Company, 1983.

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10EEM251
AI APPLICATION TO ENERGY MANAGEMENT

Overview of Artificial Intelligence: Problem solving. State space representation.

Searching Techniques : Breadth first search. Depth first search. Heuristics search A and AO algorithms.

Knowledge Representation Schemes: Predicate logic. Resolution. Proof by refutation. Semantic nets. Scripts and frames. Reasoning and planning.

AI Applications to Energy Forecasting: Short term and long term prediction using neural networks. Genetic algorithms and their application to economic load dispatch. Security analysis using neural computing techniques.

REFERENCE BOOKS:

1. Alien Riche & Kerningham, "**Artificial Intelligence**", Tata McGraw-Hill.
2. Wood and Woolen Berg, "**Power System Operation and Control**".
3. IEEE Transactions on Power Systems.

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10EEM252
ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL

Introduction: Over view of environmental system. Environmental legislation and regulation. Environmental ethics. Material balance approach to problem solving.

Water Quality Management: Water pollution and their sources.Water quality management in rivers, lakes and ocean.

Waste Water Treatment: Waste water micro-biology. Characteristics of waste water. On site disposal systems. Municipal waste water treatment systems unit. Operations of pre-treatment-primary treatment unit. Process of secondary treatment. Disinfection. Land and sludge treatment. Sludge disposal.

Air Pollution: Physical and chemical fundamentals. Air pollutants and standards. effects of air pollution. Fate of air pollution. Micro and macro air pollution. Air pollution metrology. Atmospheric dispersion. Air pollution control of stationary and mobile sources. Waste disposal.

Noise Pollution: Effects of noise, sources and criteria. Transmission of sound outdoors. Traffic noise. Protection. Noise control.

Solid Waste Management: Perspective. Collection. Inter-route transfer. Disposal by sanitary landfill. Incineration. Resource conservation.

Hazardous Waste: Definition and classification of hazardous waste. Hazardous waste management. Treatment technologies. Land disposal. Ground water contamination and remedy.

Ionizing Radiation: Fundamentals. biological effects of ionizing. Radiation. Radiation standards. Radiation exposure. Radiation protection. Radioactive waste disposal.

REFERENCE BOOKS:

1. Mackenzie.L.Davis and David.A.Cornwell, "**Introduction to Environmental Engineering**", McGraw Hill, 1991.
2. Noel De Nevers, "**Air Pollution Control Engineering**", Mc Graw Hill, 1995.

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10EEM24
COMPUTER AIDED POWER SYSTEM OPERATION AND ANALYSIS

Interchange Evaluation and Power Tools: Introduction. Economy interchange. Economy interchange evaluation. Interchange evaluation with unit commitment. Multiple interchange contracts. After the fact production costing. Transmission losses in transaction evaluation. Other types of interchange. Capacity interchange. Diversity interchange. Energy banking. Emergency power interchange. inadvertent power exchange. Power tools - The energy broker system. Centralized economic dispatch of a power pool. Allocating pool saving. Problems and further readings.

Power System Security: Introduction. Factors affecting power system security. Contingency analysis. Detection of network problems - Network sensitivity factors. AC load flow methods. Correcting the generation dispatch. Correcting the generation dispatch by sensitivity methods. Compensated factors. Correcting the generation dispatch using linear programming.

State Estimation in Power Systems: Introduction. Power system state estimation. Maximum likelihood Weighted Least Squares estimation - Introduction. Maximum Likelihood Concepts. Matrix Formulation. Example of Weighted Least squares State estimation. State estimation in AC networks-Development of method. Typical results of state estimation on an AC network. Introduction to Advanced Topics in State Estimation - Detection and identification of bad measurements. Estimation of quantities not being measured. Network observability and pseudo-measurements. Applications of Power System State Estimation - Derivation of Least squares equations. Problems.

REFERENCE BOOKS :

1. Allen.J Wood Bruce F.Wollenberg, "**Power Generation Operation and Control**" ,1996.
2. .2. George L Kusic, "**Computer Aided Power System Analysis**", Prentice Hall of India Pvt. Ltd, 1989.

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10EPE21

AC-DC DRIVES

DC Drives: Single quadrant, two quadrant, two quadrant and four quadrant drives, closed loop control of DC drives.

AC Drives: Voltage and current source invertors, Inverter control, six step and PWM Operation, v/f, field oriented control for induction motor, voltage source, current source and slip energy recovery drives, closed loop control of AC drives, Brushless DC motor, stepper motor and variable reluctance motor drives, static excitation schemes of AC generator.

REFERENCE BOOKS:

1. Bose B. K, "**Modern Power Electronics & AC Drives**" IEEE press 1998.
2. Murphy JMD, Turnbull F.G., '**Thyristor Control of AC Motors**" Pergamon Press Oxford, 1998.

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10SSE331
DISTRIBUTED OPERATING SYSTEMS

1. Fundamentals: What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed Computing Environment (DCE).

2. Message Passing: Introduction, Desirable features of a Good Message Passing System, Issues in IPC by Message Passing, Synchronization, Buffering, Multidatagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC
Mechanism.

3. Remote Procedure Calls: Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC.

4. Distributed Shared Memory: Introduction, General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM.

5. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms.

6.Resource Management: Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach

7. Process Management: Introduction, Process Migration, Threads.

8. Distributed File Systems: Introduction, Desirable Features of a Good Distributed File System, File models, File–Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles.

TEXT BOOK:

1. Pradeep. K. Sinha: Distributed Operating Systems: Concepts and Design, PHI, 2007.

REFERENCE BOOK:

1. Andrew S. Tanenbaum: Distributed Operating Systems, Pearson Education, 2002.

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10SSE152
COMPUTER GRAPHICS AND VISUALIZATION

1. Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable pipelines; Performance characteristics. Graphics Programming: The Sierpinski gasket; Programming two-dimensional applications.
2. The OpenGL: The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket; Plotting implicit functions.
3. Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Picking; A simple CAD program; Building interactive models; Animating interactive programs; Design of interactive programs; Logic operations.
4. Geometric Objects and Transformations: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling. Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices; Interfaces to three-dimensional applications; Quaternions.
5. Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL; Hidden-surface removal; Interactive mesh displays; Parallel-projection matrices; Perspective-projection matrices; Projections and shadows.
6. Lighting and Shading: Light and matter; Light sources; The Phong lighting model; Computation of vectors; Polygonal shading; Approximation of a sphere by recursive subdivisions; Light sources in OpenGL; Specification of materials in OpenGL; Shading of the sphere model; Global illumination.
7. Curves and surfaces: Representation of curves and surfaces; Design criteria; Parametric cubic polynomial curves; Interpolation; Hermite curves and surfaces; Bezier curves and surfaces; Cubic B-Splines; General B-Splines; Rendering curves and surfaces; Curves and surfaces in OpenGL.

TEXT BOOK:

1. Edward Angel: Interactive Computer Graphics A Top-Down Approach with OpenGL, 5th Edition, Pearson, 2009.

REFERENCE BOOKS:

1. Donald Hearn and Pauline Baker: Computer Graphics- OpenGL Version, 2nd Edition, Pearson, 2004.
2. F.S. Hill,Jr.: "Computer Graphics Using OpenGL",2nd Edition, Pearson, 2001.
3. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, Computer Graphics, Addison-wesley 1997.

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10SSE13
TOPICS IN DATA BASE SYSTEMS

1. Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, transactions and dealing with constraint violations.
2. Object and Object-Relational Databases: Overview of Object-Oriented Concepts – Objects, Encapsulation, Type and class hierarchies, complex objects; Object model of ODMG, Object definition Language ODL; Object Query Language OQL; Overview of C++ language binding; Conceptual design of Object database. Overview of object relational features of SQL; Object-relational features of Oracle; Implementation and related issues for extended type systems; The nested relational model.
3. Enhanced Data Models for Some Advanced Applications: Active database concepts and triggers; Temporal, Spatial, and Deductive Databases – Basic concepts.
4. Data Mining and Information Retrieval: Decision-support systems; Data analysis and OLAP; Data Warehousing; Data mining; Overview of information retrieval; Relevance ranking using terms; Relevance using hyperlinks; Synonyms, Homonyms, and Ontologies; Indexing of documents; Measuring retrieval effectiveness; Web search engines; Information retrieval and structured data; Directories.
5. Parallel Databases: Introduction; I/O Parallelism; Interquery parallelism; Intraquery parallelism; Intraoperation parallelism; Interoperation parallelism; Design of parallel systems.
6. Distributed Databases: Homogeneous and heterogeneous databases; Distributed storage; Distributed transactions; Concurrency control in distributed databases; Availability; Distributed query processing; Heterogeneous distributed databases; Directory systems.
7. More Recent Applications: Mobile databases; Multimedia databases; Geographical Information Systems; Genome data management.

Laboratory Work:
(The following tasks can be implemented on Oracle or any other suitable RDBMS with support Object features)

1. Develop a database application to demonstrate storing and retrieving of BLOB and CLOB objects.
2. Develop a database application to demonstrate the representation of multivalued attributes, and the use of nested tables to represent complex objects. Write suitable queries to demonstrate their use.
3. Design and develop a suitable Student Database application. One of the attributes to me maintained is the attendance of a student in each subject for which he/she has enrolled. Using TRIGGERS, write active rules to do the following:

a. Whenever the attendance is updated, check if the attendance is less than 85%; if so, notify the Head of the Department concerned.
b. Whenever, the marks in an Internal Assessment Test are entered, check if the marks are less than 40%; if so, notify the Head of the Department concerned.

4. Design, develop, and execute a program in a language of your choice to implement the algorithm for determining relevance of a document using TF-IDF approach and demonstrate its working against suitable data.

TEXT BOOKS:
1. Elmasri and Navathe: Fundamentals of Database Systems, 5th Edition, Pearson Education, 2007.
2. Abraham Silberschatz, Henry F. Korth, S. Sudarshan: Database System Concepts, 6th Edition, McGraw Hill, 2010.

REFERENCE BOOKS:
1. Raghu Ramakrishnan and Johannes Gehrke: Database Management Systems, 3rd Edition, McGraw-Hill, 2003.
2. Connolly and Begg: Database Systems, 4th Edition, Pearson Education, 2005.

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10SCS21
FORMAL MODELS IN COMPUTER SCIENCE

1. **Propositional Logic**

Declarative sentences, Natural deduction, Propositional logic as a formal language, Semantics of propositional logic, Normal forms.

2. **Predicate Logic**

The need for a richer language, Predicate logic as a formal language, Proof theory of predicate logic, Semantics of predicate logic, Undecidability of predicate logic, Micromodels of software.

3. **Verification by Model Checking**

Motivation for verification, Linear-time temporal logic, Model checking, Branching-time logic, CTL* and the expressive powers of LTL and CTL.

4. **Program Verification**

Need for specifying and verifying code, A framework for software verification, Proof calculus for partial correctness and total correctness, Programming by contract.

5. **Introduction to Z:** Basic concepts; Z notation in Propositional logic and Predicate logic.

TEXT BOOKS:

1. Michael Huth and Mark Ryan: Logic in Computer Science, 2nd Edition, Cambridge University Press, 2004.

2. Jim Woodcock , Jim Davies: Using Z Specification, Refinement and Proof, Prentice Hall, 1996. (Online Edition: http://www.usingz.com/text/online/).

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10SCN153
SYSTEM MODELING AND SIMULATION

1. Introduction: When simulation is the appropriate tool and when it is not appropriate; Advantages and disadvantages of Simulation; Areas of application; Some recent applications of Simulation; Systems and system environment; Components of a system; Discrete and continuous systems; Model of a system; Types of Models; Discrete-Event System Simulation; Steps in a Simulation Study.
2. General Principles: Concepts in Discrete-Event Simulation, List processing.
3. Statistical Models in Simulation: Review of terminology and concepts; Useful statistical models; Discrete distributions; Continuous distributions; Poisson process; Empirical distributions.
4. Queuing Models: Characteristics of queuing systems; Queuing notation; Long-run measures of performance of queuing systems; Steady-state behavior of M/G/1 queue; Networks of queues.
5. Random-Number Generation, Random-Variate Generation: Properties of random numbers; Generation of pseudo-random numbers; Techniques for generating random numbers; Tests for Random Numbers
Random-Variate Generation: Inverse transform technique; Acceptance-Rejection technique; Special properties.
6. Input Modeling: Data Collection; Identifying the distribution with data; Parameter estimation; Goodness of Fit Tests; Fitting a non-stationary Poisson process; Selecting input models without data; Multivariate and Time-Series input models.
7. Verification, Calibration, and Validation of Simulation Models: Model building, verification, and validation; Verification of simulation models; Calibration and validation of models.
Optimization via Simulation
8. Estimation of Absolute Performance: Types of simulations with respect to output analysis; Stochastic nature of output data; Absolute measures of performance and their estimation; Output analysis for terminating simulations; Output analysis for steady-state simulations.
9. Case Study: Simulation of networked computer systems.

TEXT BOOK:

1. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol: Discrete-Event System Simulation, 5th Edition, Pearson Education, 2010.

REFERENCE BOOKS:

1. Lawrence M. Leemis, Stephen K. Park: “Discrete – Event Simulation: A First Course”, Pearson Education, 2006.
2. Averill M. “Law: Simulation Modeling and Analysis”, 4th Edition”, Tata McGraw-Hill, 2007.

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10SSE31
TOPICS IN SOFTWARE ARCHITECTURES

1. Review of Basic Concepts: What is a pattern? What makes a pattern? Pattern Categories; Relationships between patterns; Pattern description; Patterns and software architecture; What software architecture is and what it is not; Other points of view; Architectural patterns, reference models and reference architectures; Importance of software architecture; Architectural structures and views.
2. Designing the Architecture: Architecture in the life cycle; Designing the architecture; Forming the team structure; Creating a skeletal system.
3. Reconstructing Software Architectures: Introduction; Informal extraction; Database construction; View fusion; Reconstruction; Examples.
4. Software Product Lines: Introduction; What makes software product lines work? Scoping; Architectures for product lines; What makes software product lines difficult?
5. Building Systems from Off-the-Shelf Components: Impact of components on architecture; Architectural mismatch; Component-based design as search; ASEILM example.
6. Some Design Patterns: Introduction; Management: Command processor, View handler; Communication: Forwarder-Receiver, Client-Dispatcher-Receiver, Publisher-Subscriber.
7. Pattern Systems: What is a Pattern Syste?Pattern classification; Pattern selection; Pattern systems as implementation guidelines; The evolution of pattern systems.
8. Case Studies: Key Word In Context; Instrumentation Software; Mobile Robotics; Cruise Control; The World Wide Web: A case study in nteroperability; J2ee / EJB: A case study in industry-standard computing infrastructure.

TEXT BOOKS:

1. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 2nd Edition, Pearson Education, 2003.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2007.
3. Mary Shaw and David Garlan: Software Architecture-Perspectives on an Emerging Discipline, PHI Learning, 2007.

REFERENCE BOOKS:

1. E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns-Elements of Reusable Object-Oriented Software, Pearson Education, 1995.
2. Web site for Patterns: http://www.hillside.net/patterns/

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10SCN323
ADVANCES IN STORAGE AREA NETWORKS

1. Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages. Case study: Replacing a server with Storage Networks The Data Storage and Data Access problem; The Battle for size and access.
2. Intelligent Disk Subsystems: Architecture of Intelligent Disk Subsystems; Hard disks and Internal I/O Channels; JBOD, Storage virtualization using RAID and different RAID levels; Caching: Acceleration of Hard Disk Access; Intelligent disk subsystems, Availability of disk subsystems.
3. I/O Techniques: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack; Fibre Channel SAN; IP Storage.
4. Network Attached Storage: The NAS Architecture, The NAS hardware Architecture, The NAS Sotfware Architecture, Network connectivity, NAS as a storage system.
5. File System and NAS: Local File Systems; Network file Systems and file servers; Shared Disk file systems; Comparison of fibre Channel and NAS.
6. Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.
7. SAN Architecture and Hardware devices: Overview, Creating a Network for storage; SAN Hardware devices; The fibre channel switch; Host Bus Adaptors; Putting the storage in SAN; Fabric operation from a Hardware perspective.
8. Software Components of SAN: The switch's Operating system; Device Drivers; Supporting the switch's components; Configuration options for SANs.
9. Management: Planning Business Continuity; Managing availability; Managing Serviceability; Capacity planning; Security considerations.

TEXT BOOK:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Wiley India, 2007.

REFERENCE BOOKS:

1. Marc Farley: Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems, Cisco Press, 2005.
2. Robert Spalding: "Storage Networks The Complete Reference", Tata McGraw-Hill, 2003.
3. Richard Barker and Paul Massiglia: "Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs", Wiley India, 2006.

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10EC056
NETWORK PROGRAMMING

Introduction and Elementary Socket: Introduction Transport Layer Sockets Introduction Elementary TCP Sockets TCP Client/Server Example Elementary SCTP Sockets SCTP Client/Server Example Name and Address Conversions

Advanced Sockets: IPv4 and IPv6 Interoperability Daemon Processes and the inetd Superserver Advanced I/O Functions Unix Domain Protocols Nonblocking I/O ioctl Operations Routing Sockets Key Management Sockets Broadcasting Multicasting Advanced UDP Sockets Advanced SCTP Sockets Out-at-Band Data Signal-Driven I/O Threads IP Options Raw Sockets Data link Access Client/Server Design Alternatives

REFERENCE BOOKS:

1. W. Richard Stevens, Bill Fenner, Andrew M. Rudoff: "**UNIX Network Programming**". Volume 1, Third Edition, Pearson 2004
2. Barry Nance: "**Network Programming in C**", PHI 2002
3. Bob Quinn, Dave Shute: "**Windows Socket Network Programming**", Pearson 2003
4. W. Richard Stevens: "**UNIX Network Programming**". Volume 2, Second Edition

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10EC026
DESIGN OF POWER CONVERTERS

Introduction to power electronic applications like UPS, SMPS, power factor converters, motor control, lighting;

Converters: AC to DC converters; DC to DC converters; Inverters;

Drive circuits for power devices: Magnetics for switched mode converters;

Thermal design for switched mode converters; current mode control; controller designs;

Switched Mode Power Supply Circuits: regulation in isolated SMPS; magnetic amplifiers; application case studies.

REFERENCE BOOKS:

1. Ned Mohan Tore. M. Undeland and William. P. Robbins; "**Power Electronics: Converters, Applications and Design**", 3rd Edition, John Wiley and Sons, 2003.
2. G.C. Chryssis, "**High Frequency Switching Power Supplies**", McGraw Hill, 1989 (2nd Edn.).
3. Umanand. L. & Bhat. S.R. "**Design of Magnetic Components for Switched Mode Power Converters**", Wiley Eastern Publication, 1992.

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10EMS333
TESTING AND VERIFICATION OF VLSI CIRCUITS

Scope of testing and verification in VLSI design process. Issues in test and verification of complex chips, embedded cores and SOCs.
Fundamentals of VLSI testing. Fault models. Automatic test pattern generation. Design for testability. Scan design. Test interface and boundary scan. System testing and test for SOCs. Iddq testing. Delay fault testing. BIST for testing of logic and memories. Test automation.
Design verification techniques based on simulation, analytical and formal approaches. Functional verification. Timing verification. Formal verification. Basics of equivalence checking and model checking. Hardware emulation.

REFERENCE BOOKS:

1. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.
2. M. Abramovici, M. A. Breuer and A. D. Friedman, "Digital Systems Testing and Testable Design", IEEE Press, 1990.
3. T.Kropf, "Introduction to Formal Hardware Verification", Springer Verlag, 2000.
4. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers, 2001.

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10EPE24

HVDC POWER TRANSMISSION

DC Power transmission technology: General aspects of DC transmission, Comparison with AC transmission , Application, Advantages and Disadvantages of DC transmission, Description of DC transmission systems, Modern trends in DC transmission

Analysis of HVDC Converters: Effects of source inductance, equivalent circuits and characteristics of 6 pulse and 12 pulse converters.

Control and Protection methods: DC link control principles, Converter control characteristics, Firing angle control, Fault development and protection schemes, DC reactor and its design consideration, DC breakers.

Harmonics: Generation of harmonics, design of AC filters and DC filters, Reactive power control – Discussion on control strategies under steady state and transient state and Sources of reactive power in HVDC systems, Static VAR systems.

Multi Terminal DC systems:Introduction, Potential applications, Types, Control and protection

Models for analysis of AC-DC systems:Converter models,Converter control model,modeling of DC and AC networks.

Power flow analysis in AC/DC systems: Modelling of DC links,Solution of DC load flow, Per Unit system for DC quantities,Solution of AC-DC powerflow.

REFERENCE BOOKS:

1. K. R. Padiyar, "**HVDC Power Transmission Systems: Technology and System Interactions**", New age International, 1st Edition, 2008.
2. E. W. Kimbark, "**Direct Current Transmission",** Vol. I, Wiley Future Science, 1971.
3. Arrilaga, "**High Voltage Direct Current Transmission",** The Institute of Engineering and Technology, 2nd Edition, 2007.

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10EC039
ERROR CONTROL CODING

Introduction to Algebra: Groups, Fields, Binary Field Arithmetic, Construction of Galois Field GF (2^m) and its basic properties, Computation using Galois Field GF (2^m) Arithmetic, Vector spaces and Matrices.

Linear Block Codes: Generator and Parity check Matrices, Encoding circuits, Syndrome and Error Detection, Minimum Distance Considerations, Error detecting and Error correcting capabilities, Standard array and Syndrome decoding, Decoding circuits, Hamming Codes, Reed – Muller codes, The (24, 12) Golay code, Product codes and Interleaved codes.

Cyclic Codes: Introduction, Generator and Parity check Polynomials, Encoding using Multiplication circuits, Systematic Cyclic codes – Encoding using Feed back shift register circuits, Generator matrix for Cyclic codes, Syndrome computation and Error detection, Meggitt decoder, Error trapping decoding, Cyclic Hamming codes, The (23, 12) Golay code, Shortened cyclic codes.

BCH Codes: Binary primitive BCH codes, Decoding procedures, Implementation of Galois field Arithmetic, Implementation of Error correction. Non – binary BCH codes: q – ary Linear Block Codes, Primitive BCH codes over GF (q), Reed – Solomon Codes, Decoding of Non – Binary BCH and RS codes: The Berlekamp - Massey Algorithm.
Majority Logic Decodable Codes: One – Step Majority logic decoding, one – step Majority logic decodable Codes, Two – step Majority logic decoding, Multiple – step Majority logic decoding.

Convolutional Codes: Encoding of Convolutional codes, Structural properties, Distance properties, Viterbi Decoding Algorithm for decoding, Soft – output Viterbi Algorithm, Stack and Fano sequential decoding Algorithms, Majority logic decoding

Concatenated Codes & Turbo Codes: Single level Concatenated codes, Multilevel Concatenated codes, Soft decision Multistage decoding, Concatenated coding schemes with Convolutional Inner codes, Introduction to Turbo coding and their distance properties, Design of Turbo codes.

Burst – Error – Correcting Codes: Burst and Random error correcting codes, Concept of Inter – leaving, cyclic codes for Burst Error correction – Fire codes, Convolutional codes for Burst Error correction.

REFERENCE BOOKS:

1. Shu Lin & Daniel J. Costello, Jr. "**Error Control Coding**" Pearson / Prentice Hall, Second Edition, 2004. (Major Reference).
2. Blahut, R.E. "**Theory and Practice of Error Control Codes**" Addison Wesley, 1984.

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10EC012
ASIC DESIGN

Note All Designs Will Be Based On VHDL

Introduction: Full Custom with ASIC, Semi custom ASICS, Standard Cell based ASIC, Gate array based ASIC, Channeled gate array, Channel less gate array, structured get array, Programmable logic device, FPGA design flow, ASIC cell libraries
Data Logic Cells: Data Path Elements, Adders, Multiplier, Arithmetic Operator, I/O cell, Cell Compilers

ASIC Library Design: Logical effort: practicing delay, logical area and logical efficiency logical paths, multi stage cells, optimum delay, optimum no. of stages, library cell design.

Low-Level Design Entry: Schematic Entry: Hierarchical design. The cell library, Names, Schematic, Icons & Symbols, Nets, schematic entry for ASIC'S, connections, vectored instances and buses, Edit in place attributes, Netlist, screener, Back annotation

Programmable ASIC: programmable ASIC logic cell, ASIC I/O cell

A Brief Introduction to Low Level Design Language: an introduction to EDIF, PLA Tools, an introduction to CFI designs representation. Half gate ASIC. Introduction to Synthesis and Simulation;

ASIC Construction Floor Planning and Placement And Routing: Physical Design, CAD Tools, System Partitioning, Estimating ASIC size, partitioning methods. Floor planning tools, I/O and power planning, clock planning, placement algorithms, iterative placement improvement, Time driven placement methods. Physical Design flow global Routing, Local Routing, Detail Routing, Special Routing, Circuit Extraction and DRC.

REFERENCE BOOKS:

1. M.J.S .Smith, - "**Application - Specific Integrated Circuits**" – Pearson Education, 2003.
2. Jose E.France, Yannis Tsividis, "**Design of Analog-Digital VLSI Circuits for Telecommunication and signal processing**", Prentice Hall, 1994.
3. Malcolm R.Haskard; Lan. C. May, "**Analog VLSI Design - NMOS and CMOS**", Prentice Hall, 1998.
4. Mohammed Ismail and Terri Fiez, "**Analog VLSI Signal and Information Processing"**, McGraw Hill, 1994.

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10EC028
DETECTION AND ESTIMATION

Classical Detection and Estimation Theory: Introduction, simple binary hypothesis tests, M Hypotheses, estimation theory, composite hypotheses, general Gaussian problem, performance bounds and approximations.
Representations of Random Processes: Introduction, orthogonal representations, random process characterization, homogenous integral equations and eigen-functions, periodic processes, spectral decomposition, vector random processes.

Detection of Signals – Estimation of Signal Parameters: Introduction, detection and estimation in white Gaussian noise, detection and estimation in nonwhite Gaussian noise, signals with unwanted parameters, multiple channels and multiple parameter estimation.

Estimation of Continuous Waveforms: Introduction, derivation of estimator equations, a lower bound on the mean-square estimation error, multidimensional waveform estimation, nonrandom waveform estimation.

Linear Estimation: Properties of optimum processors, realizable linear filters, Kalman-Bucy filters, fundamental role of optimum linear filters.
REFERENCE BOOKS:

1. Harry L. Van Trees, "**Detection, Estimation, and Modulation Theory**", Part I, John Wiley & Sons, USA, 2001.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, "**Introduction to Statistical Signal Processing with Applications**", Pearson Education (Asia) Pte. Ltd. /Prentice Hall of India, 2003.
3. Steven M. Kay, "**Fundamentals of Statistical Signal Processing**," Volume I: "**Estimation Theory**", Prentice Hall, USA, 1998;
4. Steven M. Kay, "**Fundamentals of Statistical Signal Processing**, "Volume II: "**Detection Theory"**, Prentice Hall, USA, 1998.
5. K Sam Shanmugam, Arthur M Breipohl, "**Random Signals: Detection, Estimation and Data Analysis**", John Wiley & Sons, 1998.

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10LBI334
ERGONOMICS

Introduction: Principles, Scope and Application of Ergonomics

Anthropometry: Basic definitions, Body dimensions and importance

Musculo Skeletal Disorders: Muscular energy, Dynamic and static effort, postures, Types of disorders their courses and remedies, fatigue, Boredom.

Workstation Design: Design of furniture and lighting computer and office workstations, Operations theatre equipments and their arrangement, Dental chair, Wheel chair.

Environmental Factors: Effects of noise and vibration on the human body, Remedies- Measurements of vibration and noise levels, effect of temperature and humidity on human body.

TEXT BOOKS:

1. **"Grandjaen, Fitting the task to Man**", Taylor Pub, 1982
2. Sanders, "**Human factors in Engg. & Design"**, MGH, 1993
3. D.Majumdar and W.Selvamurthy, "**Advances in Ergonomics, occupational Health and Safety**", New Age international Ltd.

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10EPE151
EMBEDDED SYSTEM DESIGN

Introduction to Embedded System: An embedded system, processor, hardware unit, soft ware embedded into a system, Example of an embedded system, OS services, I/O, N/W, O/S. Real time and embedded OS.

Processor and Memory Organization: Structural unit in a processor, processor selection for an embedded systems. Memory devices, memory selection for an embedded system, allocation of memory to program statements and blocks and memory map of a system. Direct memory accesses.

Micro chip PIC Microcontroller: Introduction to 16Fxx controller, CPU Architecture, Addressing modes, Instruction set, Assembly level programming, Timers, Interrupts, ADC, UART, DAC using PWM,I^2C Bus for Peripheral Chip Access,

REFERENCE BOOKS:

1. Rajkamal "**Embedded System Architecture: Programming & Design"**, TMH Edition, 2007.
2. John B. Peatman "**Design with PIC Microcontrollers**", Prentice Hall, 1997.
3. J. W. Valvano " **Embedded Microcomputer System: Real time interfacing**", Cengage-Engineering, 1st Edition, 2000.
4. Jane W.S. Liu, "**Real Time Systems**", Prentice Hall, 2000.

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10EC121
DIGITAL SYSTEM DESIGN USING VERILOG

Introduction and Methodology:
Digital Systems and Embedded Systems, Binary representation and Circuit Elements, Real-World Circuits, Models, Design Methodology.

Combinational Basics:

Boolean Functions and Boolean Algebra, Binary Coding, Combinational Components and Circuits, Verification of Combinational Circuits.

Number Basics:

Unsigned and Signed Integers, Fixed and Floating-point Numbers.

Sequential Basics: Storage elements, Counters, Sequential Datapaths and Control, Clocked Synchronous Timing Methodology.

Memories: Concepts, Memory Types, Error Detection and Correction.

Implementation Fabrics: ICs, PLDs, Packaging and Circuit Boards, Interconnection and Signal Integrity.

Processor Basics: Embedded Computer Organization, Instruction and Data, Interfacing with memory.

I/O interfacing: I/O devices, I/O controllers, Parallel Buses, Serial Transmission, I/O software.

Accelerators: Concepts, case study, Verification of accelerators.

Design Methodology: Design flow, Design optimization, Design for test,

REFERENCE BOOKS:
1. "**Digital Design: An Embedded Ssytems Approach Using VERILOG",** Peter J. Ashenden, Elesvier, 2010.

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10EC043
IMAGE AND VIDEO PROCESSING

Introduction: 2D systems, Mathematical preliminaries – Fourier Transform, Z Transform, Optical & Modulation transfer function, Matrix theory, Random signals, Discrete Random fields, Spectral density function.

Image Perception: Light, Luminance, Brightness, Contrast, MTF of the visual system, Visibility function, Monochrome vision models, Fidelity criteria, Color representation, Chromaticity diagram, Color coordinate systems, Color difference measures, Color vision model, Temporal properties of vision.

Image Sampling and Quantization: Introduction, 2D sampling theory, Limitations in sampling & reconstruction, Quantization, Optimal quantizer, Compander, Visual quantization.

Image Transforms: Introduction, 2D orthogonal & unitary transforms, Properties of unitary transforms, DFT, DCT, DST, Hadamard, Haar, Slant, KLT, SVD transform.

Image Representation by Stochastic Models: Introduction, one-dimensional Causal models, AR models, Non-causal representations, linear prediction in two dimensions.

Image Enhancement: Point operations, Histogram modeling, spatial operations, Transform operations, Multi-spectral image enhancement, false color and Pseudo-color, Color Image enhancement.

Image Filtering & Restoration: Image observation models, Inverse & Wiener filtering, Fourier Domain filters, Smoothing splines and interpolation, Least squares filters, generalized inverse, SVD and Iterative methods, Maximum entropy restoration, Bayesian methods, Coordinate transformation & geometric correction, Blind de-convolution.

Image Analysis & Computer Vision: Spatial feature extraction, Transform features, Edge detection, Boundary Extraction, Boundary representation, Region representation, Moment representation, Structure, Shape features, Texture, Scene matching & detection, Image segmentation, Classification Techniques.

Image Reconstruction from Projections: Introduction, Radon Transform, Back projection operator, Projection theorem, Inverse Radon transform, Fourier reconstruction, Fan beam reconstruction, 3D tomography.

Image Data Compression: Introduction, Pixel coding, Predictive techniques, Transform coding, Inter-frame coding, coding of two tone images, Image compression standards.

Video Processing: Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 and beyond, Content based video indexing.

REFERENCE BOOKS:

1. K. Jain**,** "**Fundamentals of Digital Image Processing"**, Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2004.
2. Z. Li and M.S. Drew**,** "**Fundamentals of Multimedia"**, Pearson Education (Asia) Pte. Ltd., 2004.
3. R. C. Gonzalez and R. E. Woods, "**Digital Image Processing"**, 2nd edition, Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2004.
4. M. Tekalp, "**Digital Video Processing"**, Prentice Hall, USA, 1995.

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10EC040
ETHERNET TECHNOLOGY

Introduction: Introduction to Ethernet, The Evolution of Ethernet, The Ethernet System, The Media Access Control Protocol The media Access Control Protocol Full Duplex Ethernet Auto-Negotiation

Ethernet Media Systems: Ethernet Media Fundamentals Twisted-Pair Media System(10Base-T) Fiber Optic Media System(10Base-F) Fast Ethernet Twisted-Pair Media System(100Base-TX) Fast Ethernet Fiber Optic Media System(100Base-FX) Gigabit Ethernet Twisted-Pair Media System(1000Base-T) Gigabit Ethernet Fiber Optic Media System (1000Base-X) Multi-Segment Configuration Guidelines

Building Your Ethernet System: Structured Cabling Twisted-Pair Cables and Connectors Fiber Optic Cables and Connectors Ethernet Repeater Hubs Ethernet Switching Hubs

Performance and Troubleshooting: Ethernet Performance Troubleshooting

REFERENCE BOOKS:

1. Charles E. Spurgeon: "**Ethernet – The Definitive Guide**", O'Reilly 2004.
2. Rich Seifert: "**Gigabit Ethernet**", Addison-Wesley 1998.

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10EC125
PROTOCOL ENGINEERING

Communication Model, software, subsystems, protocol development methods, protocol engineering process ;

Network Reference Model: services and interfaces, protocol functions, OSI and TCP/IP model,

Protocols: Host to network interface protocols, network protocols transport protocols, application protocols;
Protocol Specifications: Components of protocol, service specifications, entity specifications, interface and interactions, multimedia protocol specifications, HDLC, ABP and RSVP specifications;

SDL: features, communication system using SDL, examples of SDL based protocol specifications, other specification languages;
Protocol Verification, FSM based verification, validation, design errors, validation approaches, verification and validation of ABP using **SDL;** Conformance testing, framework, conformance test architectures, test sequence generation methods, TTCN, multimedia testing,

MPLS Testing; Performance testing methods, testing of TCP and OSPF, interoperability testing, scalability testing;

Protocol Synthesis Algorithms, resynthesis, protocol implementation requirements, methods of implementation, protocol compilers, tools for protocol engineering Assignments / practical can be chosen from the Appendix of the mentioned reference books, particularly –book 1.

REFERENCE BOOKS:

1. Pallapa Venkataram, Sunil Kumar Manvi, "**Communication Protocol Engineering**", PHI, 2004.
2. G. J. Holtzmann, "**Design and validation of Computer protocols**", Prentice hall, 1991 (available on web).
3. K. Tarnay, "**Protocol Specification and Testing**", Plenum press, 1991.

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10SSE321
SOFT COMPUTING

1. Neural Networks: History, overview of biological Neuro-system, Mathematical Models of Neurons, ANN architecture, Learning rules, Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithmsperceptions, Training rules, Delta, Back Propagation Algorithm, Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.
2. Fuzzy Logic: Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation.
3. Operations on Fuzzy Sets, Fuzzy Arithmetic, Fuzzy Logic, Uncertainty based Information: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations .Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations.
Classical Logic, Multivalued Logics, Fuzzy Propositions, Fuzzy Qualifiers, Linguistic Hedges. Information & Uncertainty, Nonspecificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets..
4. Introduction of Neuro-Fuzzy Systems: Architecture of Neuro Fuzzy Networks, Applications of Fuzzy Logic: Medicine, Economics etc.
5. Genetic Algorithms: An Overview, GA in problem solving, Implementation of GA.

TEXT BOOKS:

1. Anderson J.A.: An Introduction to Neural Networks, PHI, 1999.
2. Hertz J. Krogh, R.G. Palmer: Introduction to the Theory of Neural Computation, Addison-Wesley, 1991.
3. G.J. Klir & B. Yuan: Fuzzy Sets & Fuzzy Logic, PHI, 1995.
4. Melanie Mitchell: An Introduction to Genetic Algorithm, PHI, 1998.

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10EPE11
APPLIED MATHEMATICS

Numerical methods: Solution of algebraic and transcendental equations- Iterative methods based on second degree equation – Muller method,(no derivation) Chebyshev method, general iteration method (first order). Acceleration of convergence, system of non-linear equations, and complex roots – Newton-Raphson method, polynomial equations – Birge –Vieta method and Bairstow's method.

Numerical solution of partial differential equations: classification of second order equations, Parabolic equations- Solution of one dimensional heat equation, explicit method ,Crank-Nicolson method and Du Fort-Frankel method, Hyperbolic equations- Solution of one dimensional wave equation.

System of linear algebraic equations and Eigen value problems: Iterative methods - Gauss-Seidal method, SoR method, Eigen value problems – Gerschgorian circle, Eigen values and Eigen vectors of real symmetric matrices -Jacobi method,Given method.
Interpolation: Hermite Interpolation, Spline interpolation, Numerical solution of differential equations – Numerov method.
Integer arithmetic: Eucledian algorithm, the Diaphantine equation, Linear congruence, Fermats little theorem, Euler's Phi- function – properties, Euler's theorem.
Optimization: Linear programming- Formulation of the problem, Graphical method, General linear programming problem, simplex method, Artificial variable techinique -M-method.
Linear Algebra: Vector spaces, linear dependent, independence, Basis and Dimension, Elementary properties, Examples.
Linear Transformations: Definition, properties, range and null space, rank and nullity, Algebra of linear transformations- invertible, singular and non-singular transformations, representation of transformations by matrices.

REFERENCE BOOKS:

1. M K Jain, S R K Iyengar and R K Jain, Numerical methods for Scientific and Engineering Computations, 2003, New Age International.
2. M K Jain, Numerical Solution of Differential equations, 2nd Edition, Wiley Eastern.
3. Dr, B.S. Grewal, Numerical methods in Engineering and Science, Khanna Publishers.
4. David M Burton, Elementary Number Theory, 6th Edition, 2006. Tata McGrawHill publications,
5. Dr, B.S. Grewal, Higher Engineering Mathematics, 40th Edition, Khanna Publishers.
6. Linear Algebra, Kenneth Hoffman and Ray Knuze, 2nd Edition, Prentice Hall India.

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10LBI254
BIOINFORMATICS AND APPLICATIONS

The Central Dogma : Watson's definition, information flow, from data to knowledge, Convergence, the organization of DNA, the organization of Proteins.
XML (Bio XML) for Bioinformatics : Introduction, Differences between HTML and XML, fundamentals of XML, fundamentals of XML namespaces. Introduction to DTDs, Document type Declarations, Declaring elements, declaring attributes, working with entities XML Schemas, Essential Concepts, working with simple types, working with complex types, Basic namespaces issues.

Perl (Bioperl) for Bioinformatics : Representing sequence data, program to store a DNA sequence, concatenating DNA fragments, Transcription, Calculating the reverse complement in Perl, Proteins, files, reading proteins in files, Arrays, Flow control, finding motifs, counting Nucleotides, exploding strings into arrays, operating on strings, writing to files, subroutines and bugs.

Databases : Flat file, Relational, object oriented databases, object Relational and Hypertext, Data life cycle, Database Technology, Database Architecture, Database Management Systems and Interfaces.

Sequence Alignment Algorithms : Biological motivations of sequence analysis, the models for sequence analysis and their biological motivation, global alignment, local alignment, End free-space alignment and gap penalty, Sequence Analysis tools and techniques.

Phylogenetic Analysis : Introduction, methods of Phylogenetic analysis, distance methods, the neighbor-Joining (NJ) method, The Fitch/ Margoliash method, character-based methods, Other methods, Tree evaluation and problems in phylogenetic analysis.
Clustering, Protein structure visualization and Protein structure prediction.

TEXT BOOKS:

1. **"Bioinformatics Methods and Applications",** S.C.Rastogi, N. Mendiratta, CBS publications, 2004
2. **"Beginning Perl for Bioinformatics"** James D. Tisdall, O'Reilly media, first edition, 2001
3. **"Bioinformatics Computing"** Bryan Bergeron, M.D, Pearson education, 2003
4. **"XML for Bioinformatics**" CERAMI, ERBS

REFERENCE BOOKS:

1. **"Bioinformatics"** D.R. Westhead, J.H. Parish, Viva books private limited
2. **"Bioinformatics"** AttWood, pearson education,2004

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10EPS14
ADVANCED POWER SYSTEM ANALYSIS AND STABILITY

Load Flow Analysis*:* Review of recent trends in load flow studies, NR method, De-coupled, fast De-coupled and DC load flow, optimal load flow.
Power System Reliability Analysis*:* Basic concepts, Modes of failure, generating system and its performance, Reliability Index-steady state and general reliability expressions.

Transient Stability Studies: swing equation, Transient stability studies using Runge-Kutta method, long term transient stability studies.

Dynamic Stability*:* Concept of dynamic stability, effect of saliency and saturation on Stability, Demello-Concordia model, dynamic stability assessment using torque angle loop analysis, effect of excitation on stability.

Power System Stabilizer: Introduction, Basic concepts & structure of power system stabilizer.

Stability: Introduction, definition, time frames for voltage instability, mechanism scenarios, relation of voltage stability to rotor angle stability, voltage stability analysis by PV & VQ curves.

REFERENCE BOOKS:

1. Stagg & El-Abiad, "**Computer Methods in Power System Analysis'**. McGraw Hill
2. Nagarath & Kothari, "**Modern Power System Analysis**", TMH
3. R.N.Dhar, "**Computer Aided Power System Operation & Analysis**", TMH
4. A,K,Mahalanabis. Kothari, Ahson, "**Computer aided Power system analysis & control**"
5. Allen Wood and Woolenberg, "**Power Generation Operation and Control**"
6. Kimbark, "**Power system Stability Vol-III**"
7. K.R.Padiyar, "**Power System Dynamics, Stability & Control** ", Interline Publishing
8. C. W.Taylor, "**Power System Voltage Stability**", McGraw Hill
9. P.M Anderson, A A Fouad, "**Power System Control & Stability**",IEEE Press

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Group III

10EPS251
POWER SYSTEM INSTRUMENTATION

Measurement of large currents and voltages, current and voltage transformers, design equations and operational characteristics, error compensation schemes.

Protective CTs and PTs, overload and transient performance, standard specification of instrument transformers.

DC current transformers, measurement of power and energy, torque equation of induction type energy meter, parasitic torque's and their minimization, IS Specifications, analog and digital KVA meters.

Tele-metering, remote terminal units, data acquisition systems, tri-vector meters, event and disturbance recorders.

REFERENCE BOOKS:

1. Cooper Helfrick, "**Electrical Instrumentation and Measuring Techniques**", Prentice Hall India, 1986.
2. D.C.Nakra and K.K.Chowdhry, "**Instrumentation, Measurement, and Analysis"**, Tata McGraw Hill Publishing Co., 1984.

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10EEM21

PHOTO VOLTAIC CELLS

Introduction: Photo-voltaic energy conversion. Solar cells and solar energy conversion. Solar cell applications.

Photo-voltaic Cell Characteristics: Basic concepts. Manufacturing methods. Theory of operation.

Performance Characteristics of Photo-voltaic Cells: Open circuit voltage. Power output. Series and parallel connections. Operation with series applied voltage. Dynamic response. Output stability and temperature effects.

Homo-junction and Hetero-junction Solar Cells: Homo-junction cell configuration and performance. S-S and S-I-S hetero-junction cell configurations and performance.

Photo-voltaic Power Supplies: General application and rules of thumb. Uses of secondary batteries.

Miscellaneous Applications: Self switching flasher. Stroboscope. Photo-electric counter. Automatic tape stop for recorder. Light compass and galvanometer amplifier. Self lighting portable lamp. Street lighting control. Pinhole detectors. Photocell chopper. Uses of capacitors.

Silicon Solar Cells and Solar Energy: Mechanical features. Operation.. Stationary Silicon Solar Cell Converter Calculation: Insulation on clear days. Silicon solar cell characteristics. Calculations for a converter of given output.

Conversion Efficiency and Calibration of Silicon Solar Cells: Present calibration procedure. Proposed AIEE method. Tungsten Sun method. Solar Simulator Sun method.

REFERENCE BOOKS:

1. "**Solar Cells and Photovoltaics**", McGraw hill Book Company 1982.
2. Stephen.J.Fonash, "**Solar Cell Device Physics**" , Academic Press, 1982.
3. T.J. Couts and J.D. Meakin, "**Current Topics in Photovoltaics**".Academic Press, 1990.

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10EPS13
SOLID STATE RELAYS AND PROTECTION

Role of protection in power systems, concept of protective chain, transient analysis of current and potential transducers, solid state relays, application of semiconductor devices to protection, static over current and static over voltage relays, Co-ordination of current relays.
Microprocessor based protective relays, functional block diagram, Microprocessor based over current relay, Microprocessor based voltage relays, application of expert systems for power system protection.

Comparators, two input phase and amplitude Comparators, duality between phase and amplitude Comparators,
Protection of generator and transformer, harmonic restrained relay, combined differential protection of transformer and generator, modern static bus bar protection frequency relays, frequency relays with df / dt attachment.
Distance protection, types, polarization, switched distance scheme, star-Delta Switching, inter-phase switching, pilot wire protection, carrier protection, phase and directional comparison scheme.
Protection of distribution system, different methods of protective device co-ordination Reliability. Testing and maintenance of protective relays.

REFERENCE BOOKS:

1. Ravindranath and Chander, "**Power System Protection and Switch Gear**"
2. T.S.Madhava Rao, "**Static Relays with Microprocessor Application**"

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10EPS332

OVER VOLTAGE PHENOMENA IN POWER SYSTEM

Over Voltages in Power System: Transient phenomena on transmission lines: infinite line definition and its transient behavior, finite line analyses, Beweley Lattice diagram, line terminations, problems.

Use of transient network Analyzer, digital and hybrid computers for solving large-scale problems

Characteristics of lightning discharges, theory of cloud formation, origin of lightning, iso-keronic level, leader development, backstroke, different types of line interaction, back flashover, shielding angle calculation for HV/EHV/UHV lines, grounding rods, counter poise, problems, Origin and characteristics of switching over voltages and temporary over voltages, problems on switching surges.

Behavior of apparatus and line insulation under all types of over voltages, concept of BIL, protection of apparatus against over voltages, surge arresters, insulation co-ordination, use of standards in the design of transmission line insulation against over voltages, introduction to use of EMTP, MATLAB and PSPICE packages to solve transient problems.

REFERENCE BOOKS:

1. Ragaller K, "**Surges in High Voltage Networks**", Plenum press, 1980.
2. Begamudre, "**EHV Transmission**", 1 & 2 edition, PHI.
3. EPRI, Transmission line reference Book – 345 kV and above,1984.
4. Ashtafaq Hussain, Power systems, PHI.
5. Green wood, "**Power System Transients**", Orient longman, 1987.
6. IEEE publication, Surge Protection in power systems, No. 79, EHO 144-6-PWR.

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10EPE332

FACTS CONTROLLERS

Introduction: Basics of Power Transmission Networks - Control of Power Flow in AC - Transmission Line- Flexible AC Transmission System Controllers – Application of FACTS Controllers in Distribution Systems

AC Transmission Line and Reactive Power Compensation
Analysis of Uncompensated AC Line - Passive Reactive Power Compensation - Compensation by a Series Capacitor Connected at the Midpoint of the Line - Shunt Compensation Connected at the Midpoint of the Line - Comparison between Series and Shunt Capacitor - Compensation by STATCOM and SSSC - Some Representative Examples

Static Var Compensator
Analysis of SVC - Configuration of SVC- SVC Controller – Voltage Regulator Design - Some Issues - Harmonics and Filtering - Protection Aspects – Modeling of SVC - Applications of SVC

Thyristor and GTO Controlled Series Capacitor
Introduction - Basic Concepts of Controlled Series Compensation -Operation of TCSC - Analysis of TCSC- Control of TCSC - Modeling of TCSC for Stability Studies - GTO Thyristor Controlled Series Capacitor (GCSC) - Mitigation of Sub synchronous Resonance with TCSC AND GCSC - Applications of TCSC

Static Phase Shifting Transformer
General - Basic Principle of a PST - Configurations of SPST Improvement of Transient Stability Using SPST - Damping of Low Frequency Power Oscillations - Applications of SPST

Static Synchronous Compensator (STATCOM)
Introduction - Principle of Operation of STATCOM - A Simplified Analysis of a Three Phase Six Pulse STATCOM - Analysis of a Six Pulse VSC Using Switching Functions - Multi-pulse Converters Control of Type 2 Converters - Control of Type 1 Converters - Multilevel Voltage Source Converters - Harmonic Transfer and Resonance in VSC Applications of STATCOM

REFERENCE BOOKS:

1. K.R Padiyar**, "FACTS Controllers in power transmission and distribution",** New Age International, 2007.
2. Narain G Hingorani and L. Gyugyi, "**Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems**", Standard Publishers, New-Delhi.
3. Y. H. Song and A. T. Johns, **"Flexible AC Transmission System",** Institution of Engineering and Technology, 2009.

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10SSE21
TOPICS IN SOFTWARE ENGINEERING – II

1. Agile development: What is agile? Agility and cost of change; What is an agile process? Extreme programming; Other agile process models.
2. Web Application Design: Web application design quality; Design quality and design pyramid; Interface design; Aesthetic design; Content design; Architecture design; Navigation design; Component-level design; Object-oriented hypermedia design method.
3. Formal Modeling and verification: The cleanroom strategy; Functional specification; Cleanroom design; Cleanroom testing; Formal methods: Concepts; Applying mathematical notation for formal specification; Formal specification languages.
4. Software Project Management: The management spectrum; The management of people, product, process and project; The W5HH
Principle; Critical practices.
5. Estimation for Software Projects: Software project estimation; Decomposition techniques, Examples; Empirical estimation models; Estimation for Object-Oriented projects; Specialized estimation techniques; The make / buy decision.
6. Software Project Scheduling: Basic concepts and principles of project scheduling; Defining task set and task network; Scheduling; Earned value analysis.
7. Risk Management: Reactive versus proactive strategies; Software risks; risk identification; Risk projection; Risk refinement; Risk mitigation, monitoring and management; The RMMM plan.
8. Maintenance and Reengineering: Software maintenance; Software supportability; Reengineering; Business process reengineering; Software reengineering; Reverse engineering; Restructuring; Forward engineering; The economics of reengineering.
9. Software Process Improvement (SPI): Approaches to SPI; Maturity models; The SPI process; The CMMI; The People CMM; Other SPI frameworks: SPICE, Bootstrap, PSP and TSP, ISO; SPI return on investment.
10. Software Configuration Management (SCM): Basic concepts; SCM repository; The SCM process; Configuration management for web applications; SCM standards.
11. Product Metrics: A framework for product metrics; Metrics for requirements model, design
model, source code, testing and maintenance; Design metrics for web applications.
12. Process and Project Metrics: Basic concepts; Software measurement; Metrics for software quality; Integrating metrics within the software process; Metrics for small organizations; Establishing a software metrics program.

TEXT BOOK:
1. Roger S. Pressman**:** Software Engineering: A Practitioner's Approach, 7th Edition, McGraw Hill, 2007.

REFERENCE BOOK:
1. Ian Sommerville: Software Engineering, 8th Edition, Pearson, 2007.

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10EPS153

HIGH VOLTAGE POWER TRANSFORMERS

Power Transformer: Equivalent circuit- limitations and validity-separation of leakage reactance,

Magnetic Leakage and Reactance Calculation*:* Inductance evaluation in winding and three winding transformers, interleaved coils, arbitrary MMF distribution, Scott connection, zigzag and coils of unequal height cases,

Electro Magnetic Forces on Short Circuit*:* Philosophy, evaluation of radial and tensile forces, hoop tension and copper loss, axial force calculation, volts per turn and concept of AT thinning, magnetizing current inrush phenomena-estimation of magnitude of inrush current and its maximum value, Inrush current in three phase transformers, eddy current loss in conductors placed in alternating magnetic field, its evaluation and minimization in transformer.

On-Load Tap Changing (OLTC): Reactor type-buffer reactor, symmetrical and asymmetrical types, voltage across open selector switches-OLTC with single untapped reactor, resistor type of OLTC, comparison of reactor and resistor cycles.

Surge Phenomena In Transformers*:* Equivalent circuit-initial voltage distribution with grounded and insulated neutral, voltage gradient-line end stress, effective capacitance evaluation, role of inductance, travelling wave theory-frequency behavior of velocity of propagation-equivalent circuits-Fourier spectrum of unit step wave, standing wave theory for earthed neutral and insulated neutral cases, insulation requirement of transformers against surges-principle of fully shielded transformers and interleaved disc coils.

REFERENCE BOOKS:

1. SJS.Vasutinsky, **Principles, Operation mid Design of Power Transformers,** PSG college of Technology, Coimbatore, 1962.
2. L.F.Blume, A. Boyajian, G.Camilii, T.C.Leniiox, S.Minner and V.M.Montsinger, "**Transformer Engineering",** II edition, John Wiley and Sons Inc., New York, Chapman and Hall limited, London, 1951.

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10EEM332
ENVIRONMENTAL ASPECTS OF POWER GENERATION AND TRANSMISSION

Constituents of the atmosphere, oxides of sulphur, nitrogen, and carbon, Green house effect, acid precipitation, particulate matter, flue-gas desulfurization systems, electrostatic precipitators, fabric filters and bag houses, thermal pollution, natural and artificial radio activity, nuclear power and the environment, radiations from nuclear power plant effluents, high level wastes. Ecological considerations, power transmission lines - right of way.

Socio economical impacts of different types of power plants, policies to promote environmentally viable technologies for power generation, environmental implications of bio-mass, restructuring of power sector for environmental benefits.

REFERENCE BOOKS:

1. M.M.El-Wakil, "**Power Plant Technology"**, McGraw Hill International edition, 1984.
2. B.G.A.Skrotzki and W.A.Vopat, "**Power station engineering and Economy"**, TMH, 1990.
3. B. R. Gupta, "**Generation of Electrical Energy**", Eurasia publishing house private limited, New Delhi, 1983.
4. Standard hand books on plant engineering.
5. Selected topics from Journals.

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10EC119
BROADBAND WIRELESS NETWORKS

Wimax genesis and framework: 802.16 std., wimax forum, other 802.16 stds. Protocol layer topologies: layers of wimax, CS, MAC CPS, security layer, phy layer, reference model, topology.

Frquency utilization and system profiles: cellualar concept, licensed and unlicensed frequencies, fixed wimax system profiles, mobile wimax profiles.

Wimax physical layer: OFDM transmission, SOFDMA, subcarrier permutation, 802.16 transmission chains, channel coding, turbo coding, burst profile.

Wimax MAC and QOS: CS layer, MAC function and frames, multiple access and burst profile, uplink bandwidth allocation and request mechanisms, network entry and QoS magmt.

Radio engg considerations, radio resource management, advance antenna technology in wimax, MBS. Wimax architecture, mobility handover and power save modes. Security.

REFERENCE BOOKS:

1. Loutfi Nuyami, "**WIMAX: technology for broadband access"**,John Wiley, 2007.
2. Yan Zhang, Hsia Hwa Chen, "**Mobile WIMAX",** Aurobech publications, 2008.

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10SCE321
OOAD & DESIGN PATTERNS

1. Introduction, Modeling Concepts, class Modeling: What is Object Orientation? What is OO development? OO themes; Evidence for usefulness of OO development; OO modeling history Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models; Practical tips.

2. Advanced Class Modeling, State Modeling: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived data; Packages; Practical tips. State Modeling: Events, States, Transitions and Conditions; State diagrams; State diagram behavior; Practical tips.

3. Advanced State Modeling, Interaction Modeling: Advanced State Modeling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models; Practical tips. Interaction Modeling: Use case models; Sequence models; Activity models. Use case relationships; Procedural sequence models; Special constructs for activity models.

4. Process Overview, System Conception, Domain Analysis

Process Overview: Development stages; Development life cycle. System Conception: Devising a system concept; Elaborating a concept; Preparing a problem statement. Domain Analysis: Overview of analysis; Domain class model; Domain state model; Domain interaction model; Iterating the analysis.

5. Application Analysis, System Design: Application Analysis: Application interaction model; Application class model; Application state model; Adding operations. Overview of system design; Estimating performance; Making a reuse plan; Breaking a system in to sub-systems; Identifying concurrency; Allocation of sub-systems; Management of data storage; Handling global resources; Choosing a software control strategy; Handling boundary conditions; Setting the trade-off priorities; Common architectural styles; Architecture of the ATM system as the example.

6. Class Design, Implementation Modeling, Legacy Systems: Class Design: Overview of class design; Bridging the gap; Realizing use cases; Designing algorithms; Recursing downwards, Refactoring; Design optimization; Reification of behavior; Adjustment of inheritance; Organizing a class design; ATM example.
Implementation Modeling: Overview of implementation; Fine-tuning classes; Fine-tuning generalizations; Realizing associations; Testing. Legacy Systems: Reverse engineering; Building the class models; Building the interaction model; Building the state model; Reverse engineering tips; Wrapping; Maintenance.

7. Design Patterns: What is a pattern and what makes a pattern? Pattern categories; Relationships between patterns; Pattern description Communication Patterns: Forwarder-Receiver; Client-Dispatcher-Server; Publisher-Subscriber, Management Patterns: Command processor; View handler.

TEXT BOOKS:

1. Michael Blaha, James Rumbaugh: Object-Oriented Modeling and Design with UML, 2nd Edition, Pearson Education, 2005.
2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2006.

REFERENCE BOOKS:

1. Grady Booch et al: Object-Oriented Analysis and Design with Applications, 3rd Edition, Pearson, 2007.
2. Brahma Dathan, Sarnath Ramnath: Object-Oriented Analysis, Design, and Implementation, Universities Press, 2009.
3. Hans-Erik Eriksson, Magnus Penker, Brian Lyons, David Fado: UML 2 Toolkit, Wiley- Dreamtech India, 2004.
4. Simon Bennett, Steve McRobb and Ray Farmer: Object-Oriented Systems Analysis and Design Using UML, 2nd Edition, Tata McGraw-Hill, 2002.

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10EC124
PROBOBALITY & RANDOM PROCESS

I**ntroduction to Probability Theory:** Experiments, sample space, Events, Axioms, Assigning probabilities, Joint and conditional probabilities, Baye's Theorem, Independence, Discrete Random Variables, Engg Example.
Random Variables, Distributions, Density Functions: CDF, PDF, Gaussian random variable, Uniform Exponential, Laplace, Gamma, Erlang, Chi-Square, Raleigh, Rician and Cauchy types of random variables.

Operations on a Single R V: *Expected value, EV of Random variables, EV of functions of Random variables, Central Moments, Conditional expected values.*

Characteristic functions, Probability generating functions, Moment generating functions, Engg applications, Scalar quantization, entropy and source coding.

Pairs of Random variables, Joint CDF, joint PDF, Joint probability mass functions, Conditional Distribution, density and mass functions, EV involving pairs of Random variables, Independent Random variables, Complex Random variables, Engg Application.

Multiple Random Variables: *Joint and conditional PMF, CDF, PDF,.EV involving multiple Random variables, Gaussian Random variable in multiple dimension, Engg application, linear prediction.*

Random Process: *Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodic Random processes, Properties of ACF.*

Example Processes: *Markov processes, Gaussian Processes, Poisson Processes, Engg application, Computer networks, Telephone networks.*

REFERENCE BOOKS:

1. **Probability and random processes: application to Signal processing and communication** - S L Miller and D C Childers**:** Academic Press / Elsivier 2004.
2. **Probability, Random variables and stochastic processes** - A. Papoullis and S U Pillai: McGraw Hill 2002
3. **Probability, Random variables and Random signal principles** - Peyton Z Peebles**:** TMH 4th Edition 2007.
4. **Probability, random processes and applications** - H Stark and Woods**:** PHI 2001.

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10SCS252
TOPICS IN ARTIFICIAL INTELLIGENCE

1. Introduction and Review: What is AI? The foundations of AI, The history of AI.
2. Uncertainty: Acting under uncertainty; Inference using full joint distributions; Independence; Bayes' rule and its use; The Wumpus world revisted.
3. Probabilistic Reasoning: Representing knowledge in an uncertain domain; The semantics of Bayesian networks; Efficient representation of conditional distributions; Exact inference in Bayesian networks; Approximate inference in Bayesian Networks; Extending probability to first-order representations; Other approaches to Uncertain Reasoning.
4. Probabilistic Reasoning over Time: Time and uncertainty; Inference in temporal models; Hidden Markov models; Kalman filters; Dynamic Bayesian Networks; Speech recognition.
5. Learning from Observations: Forms of Learning; Inductive learning; Learning decision trees; Ensemble learning; Computational learning theory.
6. Knowledge in Learning: A logical formulation of learning; Knowledge in learning; Explanation-based learning; Learning using relevance information; Inductive logic programming.
7. Statistical Learning Methods: Statistical learning; Learning with complete data; Learning with hidden variables; Instance-based learning.
8. Reinforcement Learning: Introduction: Passive reinforcement learning; Active reinforcement learning; Generalization in reinforcement learning; Policy search.
9. Philosophical Foundations: Weak AI and Strong AI; The ethics and risks of developing AI.
10. AI: Present and Future: Agent components; Agent architectures; Are we going in the right direction? What if AI does succeed?

TEXT BOOK:

1. Stuart Russel, Peter Norvig: "Artificial Intelligence A Modern Approach", 2nd Edition, Pearson Education, 2003.

REFERENCE BOOKS:

1. Elaine Rich, Kevin Knight: "Artificial Intelligence", 3rd Edition, Tata McGraw Hill, 2009.
2. Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier, 1980.

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10SCS22
ADVANCED ALGORITHMS

1. Review of Analysis Techniques: Growth of Functions: Asymptotic notations; Standard notations and common functions; Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods.
2. Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite matching.
3. Polynomials and the FFT: Representation of polynomials; The DFT and FFT; Efficient implementation of FFT.
4. Number -Theoretic Algorithms: Elementary notions; GCD; Modular Arithmetic; Solving modular linear equations; The Chinese remainder theorem; Powers of an element; RSA cryptosystem; Primality testing; Integer factorization.
5. String-Matching Algorithms: Naïve string Matching; Rabin - Karp algorithm; String matching with finite automata; Knuth-Morris-Pratt algorithm; Boyer – Moore algorithms.
6. Probabilistic and Randomized Algorithms: Probabilistic algorithms; Randomizing deterministic algorithms, Monte Carlo and Las Vegas algorithms; Probabilistic numeric algorithms.

Laboratory Work:

1. Design, develop, and run a program in any language to implement the Bellman-Ford algorithm and determine its performance.
2. Design, develop, and run a program in any language to implement Johnson's algorithm and determine its performance.
3. Design, develop, and run a program in any language to implement a Monte Carlo algorithm to test the primality of a given integer and determine its performance.
4. Design, develop, and run a program in any language to solve the string matching problem using naïve approach and the KMP algorithm and compare their performances.
5. Design, develop, and run a program in any language to solve modular linear equations.
6. Design, develop, and run a program in any language to implement the FFT algorithm efficiently.

TEXT BOOKS:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3rd Edition, Prentice-Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul: Algorithms, Cengage Learning, 2002.

REFERENCE BOOK:

1. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: Fundamentals of Computer Algorithms, 2nd Edition, Universities press, 2007.

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10SSE23
TOPICS IN SOFTWARE TESTING

1. Basics of Software Testing and Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudocode, The triangle problem, The NextDate function, The commission problem, The SATM (Simple Automatic Teller Machine) problem.
2. Decision Table-Based Testing: Decision tables, Test cases for the triangle problem, Test cases for the NextDate function, Test cases for the commission problem, Guidelines and observations.
3. Data Flow Testing: Definition-Use testing, Slice-based testing, Guidelines and observations.
4. Levels of Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, Separating integration and system testing.
5. Integration Testing: A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integrations, Case study.
6. System Testing: Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines, ASF (Atomic System Functions) testing example.
7. Interaction Testing: Context of interaction, A taxonomy of interactions, Interaction, composition, and determinism, Client/Server Testing,.
8. Issues in Object-Oriented Testing: Units for object-oriented testing, Implications of composition and encapsulation, inheritance, and polymorphism, Levels of object-oriented testing, GUI testing, Dataflow testing for object-oriented software, Examples.
9. Class Testing: Methods as units, Classes as units.
10. **Object-Oriented Integration Testing:** UML support for integration testing, MM-paths for object-oriented software, A framework for object-oriented dataflow integration testing.
10. GUI Testing: The currency conversion program, Unit testing, Integration Testing and System testing for the currency conversion program.
11. Object-Oriented System Testing: Currency converter UML description, UML-based system testing, Statechart-based system testing.
12. Exploratory Testing: The context-driven school, Exploring exploratory testing, Exploring a familiar example, Exploratory and context-driven testing observations.
13. Model-Based Testing: Testing based on models, Appropriate models, Use case-based testing, Commercial tool support for model-based testing.
14. Test-Driven Development: Test-then-code cycles, Automated test execution, Java and JUnit example, Remaining questions, Pros, cons, and open questions of TDD, Retrospective on MDD versus TDD.
15. A Closer Look at All Pairs Testing: The all-pairs technique, A closer look at NIST study, Appropriate applications for all pairs testing, Recommendations for all pairs testing.
16. Software Testing Excellence: Craftsmanship, Best practice of software testing, Top 10 best practices for software testing excellence, Mapping best practices to diverse projects.

Laboratory Work:
1. Design, develop, code and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive at least 10 different test cases, excute thses test cases and discuss the test results.
2. Design, develop, code and run the program in any suitable language to solve the NextDate problem. Analyze it from the perspective of decision table-based testing, derive at least 10 different test cases, execute thess test cases and discuss the test results.
3. Design, develop, code and run the program in any suitable object-oriented language to solve the calendar problem. Analyze it from the perspective of OO testing, derive test cases to test the method that increment the date and the method that increments the month., execute these test cases and discuss the test results.
4. Design, develop, code and run the program in any suitable object-oriented language to solve the currency converter problem. Analyze it from the perspective of use case-based system testing, derive appropriate system test cases., execute these test cases and discuss the test results.

TEXT BOOK:
1. Paul C. Jorgensen: Software Testing, A Craftsman's Approach, 3rd Edition, Auerbach Publications, 2008.

REFERENCE BOOKS:

1. Aditya P Mathur**:** Foundations of Software Testing, Pearson, 2008.
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008.
3. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2nd Edition, Pearson, 2007.
4. Brian Marrick: The Craft of Software Testing, Pearson, 1995.

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10EC052
MULTIMEDIA COMMUNICATION

Multimedia Communications: multimedia information representation, multimedia networks, multimedia applications, network QoS and application QoS.

Information Representation: text, images, audio and video, Text and image compression, compression principles, text compression, image compression. Audio and video compression, audio compression, video compression, video compression principles, video compression standards: H.261, H.263, P1.323, MPEG 1, MPEG 2, Other coding formats for text, speech, image and video.

Detailed Study of MPEG 4: coding of audiovisual objects, MPEG 4 systems, MPEG 4 audio and video, profiles and levels. MPEG 7 standardization process of multimedia content description, MPEG 21 multimedia framework, Significant features of JPEG 2000, MPEG 4 transport across the Internet.

Synchronization: Notion of synchronization, presentation requirements, reference model for synchronization, Introduction to SMIL, Multimedia operating systems, Resource management, process management techniques.

Multimedia Communication Across Networks: Layered video coding, error resilient video coding techniques, multimedia transport across IP networks and relevant protocols such as RSVP, RTP, RTCP, DVMRP, multimedia in mobile networks, multimedia in broadcast networks.

Assignments / Practicals can be given on writing the programs to encode and decode the various kinds of data by using the algorithms. Students can collect several papers from journals/conferences/Internet on a specific area of multimedia communications and write a review paper and make a presentation.

REFERENCE BOOKS:

1. Fred Halsall, "**Multimedia Communications**", Pearson education, 2001.
2. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, "**Multimedia Communication Systems**", Pearson education, 2004.
3. Raif steinmetz, Klara Nahrstedt, "**Multimedia: Computing, Communications and Applications",** Pearson education, 2002.
4. John Billamil, Louis Molina, "**Multimedia : An Introduction**", PHI, 2002.

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10EPE12
POWER SEMICONDUCTOR DEVICES

Power Diodes: Basic Structure and I-V Characteristics, Breakdown Voltages and Control, On State Losses. Switching Characteristics. Turn on Transient,Turn off Transient and Reverse Recovery Transient. Schottky Diodes. Snubber requirements for Diodes, Diode Snubbers. Modeling and simulation of Power Diodes.

Thyristors: - Basic Structure. V-I Characteristics. Turn on Process. On State operation. Turn off process. Switching Characteristics. Turn on Transient and di/dt limitations. Turn off Transient. Turn off time and reapplied dv/dt limitations. Ratings of Thyristors. Snubber Requirements and Snubber Design. Modelling and simulation of Thyristors.

Triacs: Basic Structure and operation. V-I Characteristics. Ratings. Snubber Requirements. Modeling and simulation of Triacs**.**

Gate Turnoff Thyristor (GTO): Basic Structure and Operation. GTO Switching Characteristics. GTO Turn on Transient. GTO Turn off Transient, Minimum ON and OFF State times. Maximum Controllable Anode Current, Overcurrent protection of GTOs, Modelling and simulation of GTOs.

Power BJTs: Basic Structure and I-V Characteristics. Breakdown Voltages and Control. Second Breakdown and its Control- FBSOA and RBSOA Curves - On State Losses. Switching Characteristics. Resistive Switching Specifications. Clamped Inductive Switching Specifications. Turn on Transient. Turn off Transient. Storage Time. Base Drive Requirements. Switching Losses. Device Protection- Snubber Requirements for BJTs and Snubber Design - Switching Aids. Modeling and simulation of Power BJTs. Power MOSFETs - Basic Structure. V-I Characteristics. Turn on Process. On State operation. Turn off process. Switching Characteristics Resistive Switching Specifications. Clamped Inductive Switching Specifications - Turn on Transient and di/dt limitations. Turn off Transient Turn off time. Switching Losses. Effect of Reverse Recovery Transients on Switching Stresses and Losses - dv/dt limitations. Gating Requirements, Gate Charge - Ratings of MOSFETs. FBSOA and RBSOA Curves. Device Protection -Snubber Requirements. Modelling and simulation of Power MOSFETS.

Insulated Gate Bipolar Transistors (IGBTs): Basic Structure and Operation, Latch up IGBT Switching Characteristics. Resistive Switching Specifications. Clamped Inductive Switching Specifications - IGBT Turn on Transient. IGBT Turn off Transient- Current Tailing - Ratings of MOSFETs. FBSOA and RBSOA Curves. Switching Losses - Minimum ON and OFF State times - Switching Frequency Capability - Overcurrent protection of IGBTs. Short Circuit Protection. Snubber Requirements and Snubber Design.

New power semiconductor devices : MOS Gated Thyristors,MOS Controlled Thyristors or MOS GTOs, Base Resistance controlled Thyristors, Emitter Switched Thyristor. Thermal design of power electronic equipment. Modeling and simulation. Heat transfer by conduction, transient thermal impedance - heat sinks. Heat transfer by radiation and convection - Heat Sink Selection for Power Semiconductor Devices.

REFERENCE BOOKS:

1. Ned Mohan Tore.M. Undeland and William.P Robbins, "**Power Electronics converters", Applications and Design**", John Wiley and Sons, 3rd Edition, 2002..
2. G. Massobrio, P. Antognetti, "**Semiconductor Device Modeling with Spice**", McGraw-Hill, 2nd Edition, 1998.
3. B. Jayant Baliga, "**Power Semiconductor Devices**", PWS Publication, 1st Edition, 1995.
4. V. Benda, J. Gowar, and D. A. Grant, "**Discrete and Integrated Power Semiconductor Devices:Theory and Applications**", John Wiley & Sons, 1999.

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10ECD253
COMPUTER CONTROL OF ELECTRIC DRIVES

Review of Microcontrollers in industrial drives system. Typical Microcontrollers- 8 bit/16 bit/32 bit (only block diagram), Digital Data Acquisition System, voltage sensors, current sensors, frequency sensors and speed sensors.

Evolution of power Electronics in drives:
Power semiconductor devices used for drives control, GTO, BJT, Power MOSFET, IGBT, MCT and IGCT structures, Ratings, Comparison and their applications. Block diagram for power integrated circuit for DC motor drives

AC Machine Drives, general classification and National Electrical manufacturer Association (NEMA) classification, special control of induction motors with Variable voltage, constant frequency, constant voltage variable frequency,(V/f) Constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.

Synchronous Machine drives, wound field machine, comparison of induction and wound field synchronous machines, torque angle characteristics of salient Pole synchronous machine, synchronous reluctance permanent magnet Synchronous machines (SPM), variable reluctance machine (VRM)

Phase controlled converters, converter controls, linear firing angle control, Cosine wave crossing control, Phase- locked oscillator principle, Electro magnetic interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, PWM Rectifiers, current fed converters.

Principle of slip power Recovery schemes Static Kramers Drive system, block schematic diagram and phasor diagram and Limitations, static Scherbius scheme system using DC link converters with Cyclo converter modes of operation, Modified Scherbius drives for variable Source Constant Frequency (VSCF) generation.

Principle of Vector control of AC drives, Phasor diagram, digital implementation block diagram, flux vector-estimation, Indirect vector control block diagram with open loop flux control, synchronous Motor control with compensation.

Expert system Application to Drives (only block diagram approach), Expert System shell, Design methodology, ES based P-I tuning of vector controlled Drive system. Fuzzy logic control for speed controller in vector control drives Structure of fuzzy control in feedback system.

8 Hours

REFERENCE BOOKS:

1. Bimal K.Bose, "**Power Electronics and motor drives**" Elsevier, 2006.
2. Bimal K.Bose, "**Modern Power Electronics & Drives**", Pearson Education, 2003.
3. Badri Ram "**Fundamentals of Microprocessors and applications**", 2001.
4. W. Leonard "**Control of Electric drives**", Spring Verlog.

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10SCE332
Advances in Pattern Classification

1. Introduction: Polynomial Curve Fitting, Probability Theory, Probability Distributions, Model Selection, Decision Theory, Information Theory
2. Linear Models for Regression: Linear Basis Function Models, The Bias Variance Decomposition, Bayesian Linear Regression, Bayesian Model Comparison, The Evidence Approximation, Limitations of Fixed Basis Functions
3. Linear Models for Classification: Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models, The Laplace Approximation, Bayesian Logistic Regression
4. Kernel Methods: Dual Representations, Constructing Kernels, RBF Networks, Gaussian Processes, Sparse Kernel Machines: SVMs, Multiclass SVMs, Relevance Vector Machines
5. Unsupervised Learning: Introduction, Association Rules, Cluster Analysis, Self-Organizing Maps, Principal Components, Curves and Surfaces, Non-negative Matrix Factorization, Independent Component Analysis and Exploratory Projection Pursuit, Multidimensional Scaling, Nonlinear Dimension Reduction and Local Multidimensional Scaling, The Google PageRank Algorithm
6. Mixture Models and EM: Mixtures of Gaussians, An alternative view of EM, The EM Algorithm in general.
7. High-Dimensional Problems: The Curse of Dimensionality, Diagonal Linear Discriminant Analysis and Nearest Shrunken Centroids, Linear Classifiers with Quadratic Regularization, Linear Classifiers with L1 Regularization, Classification when Features are Unavailable, High-Dimensional Regression: Supervised Principal Components, Feature Assessment and the Multiple-Testing Problem.

Text Books:

1. Christopher M Bishop: Pattern Recognition and Machine Learning, Springer, 2006.
2. Trevor Hastie, Robert Tibshirani, and Jerome Friedman: The Elements of Statistical Learning, Springer, 2008.

Reference Books:

1. R. O. Duda, P. E. Hart, and D. G. Stork: Pattern Classification by 2nd edition, Wiley –Interscience, 2001.
2. Sergios Theodoridis and Konstantinos Koutroumbas: Pattern Recognition, 2nd Edition, Elsevier, 2003.

10EC020
CMOS RF CIRCUIT DESIGN

Introduction to RF Design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Intersymbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion

RF Modulation: Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, Direct conversion and two-step transmitters

RF Testing: RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

BJT and MOSFET Behavior at RF Frequencies: BJT and MOSFET behavior at RF frequencies, modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation

RF Circuits Design: Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, Various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier design, Liberalization techniques, Design issues in integrated RF filters.

REFERENCE BOOKS:

1. B. Razavi, "**RF Microelectronics**" PHI 1998
2. R. Jacob Baker, H.W. Li, D.E. Boyce "**CMOS Circuit Design, layout and Simulation**", PHI 1998.
3. Thomas H. Lee "**Design of CMOS RF Integrated Circuits**" Cambridge University press 1998.
4. Y.P. Tsividis, "**Mixed Analog and Digital Devices and Technology**", TMH 1996

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10EC068
RADAR SYSTEMS

Introduction: Range equation, Transmitter and Receiver parameters and model, Types of Radars,

Radar Signal Transmission; Transmitted Waveforms (Time and Frequency Domains), Energy, Radar signal analysis using autocorrelation and Hilbert Transform., Pulse Compression, Clutter — Properties, reduction, Coding and Chirp.

Radar Antenna – Reflector types , side lobe control; -Arrays;- Array factor and Beam width, Synthetic Aperture, Adaptive Antennas;

Propagation Effects- Multipath, Low Altitude, Ionosphere

Radar Networks: Matched Filter Response and noise considerations

Data Processing: Fast Fourier transform, Digital MTI, tracking, Plot Track,

Applications: Secondary Surveillance, Multi static, Over the Horizon, Remote sensing and meteorological radars.

REFERENCE BOOKS:

1. M.LSkolnjk; "**Radar Handbook**".
2. M.J.B.Scanlan; "**Modem Radar Techniques**".
3 Peyton Z Peebles, "**Radar Principles**", Wiley-Inter science.

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10EC044
JAVA TECHNOLOGY

Introduction: An Introduction to Java The Java Programming Environment Fundamental Programming Structures in Java

Core Java: Objects and Classes Inheritance Interfaces and Inner Classes Graphics Programming Event Handling User Interface Components with Swing Deploying Applets and Applications Exceptions and Debugging Streams and Files Generic Programming

Advanced Java: Multithreading Collections Networking Database Programming Distributed Objects JavaBeans Components Security Native Methods

REFERENCE BOOKS:

1. Cay S. Horstmann, "**Core Java 2, Volume I and II, VII Edition**", Pearson 2005
2. Herbert Schildt "**The Complete Reference – Java 2, Fifth Edition**", Tata McGraw-Hill 2002.
3. Bruce Eckel, "**Thinking in Java**", III Edition, Pearson 2004.

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10EC126

REAL TIME OPERATING SYSTEMS

Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems.

System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Esecutive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Reentrant Functions.

Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies.

I/O Resources:
Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture.
Memory:
Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash filesystems.

Multiresource Services:
Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion.

Soft Real-Time Services:
Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services.

Embedded System Components:
Firmware components, RTOS system software mechanisms, Software application components.

Debugging Components:
Execptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics, External test equipment, Application-level debugging.

Performance Tuning:
Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency, Fundamental optimizations.

High availability and Reliability Design:
Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design trade offs, Hierarchical applications for Fail-safe design.

Design of RTOS – PIC microcontroller. **(Chap 13 of book Myke Predko)**
REFERENCE BOOKS:

1. "**Real-Time Embedded Systems and Components" ,** Sam Siewert, Cengage Learning India Edition, 2007.
2. " **Programming and Customizing the PIC microcontroller" ,** Myke Predko, 3rd Ed, TMH, 2008.
3. "**Programming for Embedded Systems**", Dreamtech Software Team, John Wiley, 2008.
4. "**Embedded Linux: Hardware, Software & Interfacing**" , Carig Hollabaugh, Pearson Education, 2009.

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10SCN14
INFORMATION SECURITY

1. Introduction to Information Security: Introduction; What is security? Critical characteristics of information; NSTISSC security model; Approaches to information security implementation; The Security System Development Life Cycle; Information Security Terminology.

2. Planning for Security: Introduction; Information Security Policy, Standards, and Practices; The Information Security Blue Print.
3. Security Technology: Firewalls and VPNs: Introduction, Physical design, Firewalls, Protecting Remote Connections. Intrusion Detection, Access control and Other Security Tools: Introduction; Intrusion Detection Systems (IDS); Honey Pots, Honey Nets, and Padded cell systems; Scanning and Analysis Tools; Access Control Devices.
4. Information Security maintenance: Introduction; Security Management Models; The Maintenance Model.
5. Introduction to Network Security: Attacks, Services, and Mechanisms; Security Attacks; Security Services; A model for Internetwork Security; Internet Standards and RFCs; Wireless network security.
6. Cryptography: Conventional Encryption Principles and Algorithms; Cipher Block Modes of Operation; Location of encryption devices; Key distribution; Approaches to message authentication; Secure Hash functions and HMAC; Public Key Cryptography Principles and Algorithms; Digital Signatures; Key management.
7. Authentication Applications: Kerberos, X.509 Directory Authentication Service.
8. Electronic Mail Security: Pretty Good Privacy (PGP), S/MIME.
9. IP Security: IP Security Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management.
10. Web Security: Web security requirements, Secure Socket layer (SSL) and Transport layer Security (TLS), Secure Electronic Transaction (SET).
11. Software: Introduction; Software flaws; Malware; Software-based attacks; Digital Rights Management;

TEXT BOOKS:
1. Michael E. Whitman and Herbert J. Mattord: Principles of Information Security, 2nd Edition, Cengage Learning, 2005.
2. William Stallings: Network Security Essentials Applications and Standards, Person, 2000.
3. Deven N. Shah: Information Security – Principles and Practice, Wiley India, 2009.

REFERENCE BOOK:
1. Behrouz A. Forouzan: Cryptography and Network Security, Tata McGraw-Hill, 2007.

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10EPE321

CMOS VLSI DESIGN

Review of MOS circuits: MOS and CMOS static plots, switches, comparison between CMOS and BI - CMOS.

MESFETS: MESFET and MODFET operations, quantitative description of MESFETS.

MIS structures and MOSFETS: MIS systems in equilibrium, under bias, small signal operation of MESFETS and MOSFETS.

Short channel effects and challenges to CMOS: Short channel effects, scaling theory, processing challenges to further CMOS miniaturization

Beyond CMOS: Evolutionary advances beyond CMOS, carbon Nano tubes, conventional vs. tactile computing, computing, molecular and biological computing, Mole electronics-molecular Diode and diode-diode logic .Defect tolerant computing,

Super buffers, Bi-CMOS and Steering Logic: Introduction, RC delay lines, super buffers- An NMOS super buffer, tri state super buffer and pad drivers, CMOS super buffers, Dynamic ratio less inverters, large capacitive loads, pass logic, designing of transistor logic, General functional blocks - NMOS and CMOS functional blocks.

Special circuit layouts and technology mapping: Introduction, Talley circuits, NAND-NAND, NOR- NOR, and AOI Logic, NMOS, CMOS Multiplexers, Barrel shifter, Wire routing and module lay out.

System design: CMOS design methods, structured design methods, Strategies encompassing hierarchy, regularity, modularity & locality, CMOS Chip design Options, programmable logic, Programmable inter connect, programmable structure, Gate arrays standard cell approach, Full custom Design.

REFERENCE BOOKS:

1. Kevin F Brrnnan "**Introduction to Semi Conductor Device**", Cambridge publications, 2005.
2. Eugene D Fabricius "**Introduction to VLSI Design**", MGH, 1990,
3. D.A Pucknell "**Basic VLSI Design**", 3rd Edition, PHI Publication, 1994.
4. Wayne Wolf, "**Modern VLSI Design**" Pearson Education, 2nd Edition , 2002.

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10EC050
MOBILE COMPUTING

Wireless and Mobile Network Architecture: Principle of Cellular Communication, Overview 1G, 2G, 2.5G and 3G and 4G technologies. GSM Architecture and Mobility management hand off management, Network signaling. Mobile Computing fundamental challenges, Mobile Devices –PDA and mobile OS, PalmOs, Win CE and Symbian.

Mobile IP Protocol Architecture: Mobile IP and IP v 6 and its application in mobile computing, Cellular Digital Packet Data CDPD, VOIP, GPRS Services, Wireless Local Loop-WLL system.

Wireless Application Protocol (WAP): The Wireless Application Protocol application environment, wireless application protocol client software, hardware and websites, wireless application protocol gateways, implementing enterprise wireless application protocol strategy,

Wireless Markup Language: An Introduction to Wireless Technologies, Markup Languages , An Introduction to XML, Fundamentals of WML., Writing and Formatting Text , Navigating Between Cards and Decks, Displaying Images, Tables, Using Variables, Acquiring User Input

Wireless Markup Language Script: An Introduction to WMLScript, WMLScript Control Structures, Events, Phone.com Extensions, Usability

Application of Mobile Computing: ASP and Dynamic WAP Sites, XML and XSLT, Dynamic WML Generation with ASP and XSLT, Developing WAP Applications using Emulators.

Distributed Mobile Computing: Distributed OS and file systems, Mobile Computing Software (Pervasive Computing) Development Strategies and tools, Data Management for Mobile Computing.

REFERENCE BOOKS:

1 Yi Bing Lin, "**Wireless and Mobile Networks Architecture**", John Wiley.
2 Wrox "**The Beginning WML and WML Script**", Wrox Publication.
3 Tomasz Imielinski et.al, "**Mobile Computing**", Kluwer Academic Press 1996.
4 Uwe Hansmann, "**Pervasive Computing Handbook. The Mobile World**", IEE publication 2002.
5 Jochen Burkhardt, et.al., "**Pervasive Computing, Technology and Architecture of Mobile Internet Applications**", Addison Wesley, 2002.

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10EC076
STATISTICAL SIGNAL PROCESSING

Random Processes: Random variables, random processes, white noise, filtering random processes, spectral factorization, ARMA, AR and MA processes.

Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion.

Spectrum Estimation: Nonparametric methods, minimum-variance spectrum estimation, maximum entropy method, parametric methods, frequency estimation, principal components spectrum estimation.
Optimal and Adaptive Filtering: FIR and IIR Wiener filters, Discrete Kalman filter, FIR Adaptive filters: Steepest descent, LMS, LMS-based algorithms, adaptive recursive filters, RLS algorithm.

Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beam-forming, linearly constrained minimum-variance beam-formers, side-lobe cancellers, space-time adaptive processing.

REFERENCE BOOKS:

1. Monson H. Hayes, "**Statistical Digital Signal Processing and Modeling"**, John Wiley & Sons (Asia) Pte. Ltd., 2002.
2. Dimitris G. Manolakis, Vinay K. Ingle, and Stephen M. Kogon, "**Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing**", McGraw-Hill International Edition, 2000.
3. Bernard Widrow and Samuel D. Stearns, "**Adaptive Signal Processing**", Pearson Education (Asia) Pte. Ltd., 2001.
4. Simon Haykin, "**Adaptive Filters**", Pearson Education (Asia) Pte. Ltd, 4th edition, 2002.
5. J.G. Proakis, C.M. Rader, F. Ling, C.L. Nikias, M. Moonen and I.K. Proudler, "**Algorithms for Statistical Signal Processing"**,

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10EC084
WEB SERVICES

Introduction: Web Services Overview What Are Web Services? History Web Services Technology Other Concerns Java and Web Services Application Scenarios Implementation Scenarios Benefits of Web Services A Word about Standards Service-Oriented Architecture SOA Entities SOA Characteristics Component-Based Service Development, Development Lifecycle Design Verification and Validation Maintenance

Technologies: SOAP The Case for SOAP What Does SOAP Define? SOAP Message Structure SOAP Message Elements SOAP Processing Model SOAP Encoding WSDL Describing a Web Service Describing Functional Characteristics of Services WSDL 1.2 UDDI Discovering Web Services Categorizing Services Identifiers Business Entity Relationships UDDI's SOAP Interfaces UDDI and SOAP/WSDL Relationships Publishing WSDL Service Interfaces in UDDI Internationalization and Multiple Languages Extending a UDDI Registry UDDI Private UDDI Registries ebXML Architectural Overview of ebXML Putting It All Together

Java Web Services: Java Web Service Developer Pack JAXP JA_XP Architecture SAX DOM When to Use SAX When to Use DOM When Not to Use Either JAXP and XML Schemas XSLT XSLTc JDOM JAXP RI JAX-RPC JAX-RPC Service Model Data Types and Serialization JAX-RPC Development Advanced JAX-RPC JAX-RPC Interoperability JAX-RPC and J2EE JAXM Messaging and MOM Messaging and Web Services Messaging in Java JAXM Architecture Designing with JAXM Developing with JAXM JAXR Registries and Repositories JAXR Architecture The JAXR Information Model The JAXR API JAXR to UDDI Mapping JAXR and ebXML Registry JAXB The Need for Binding and JAXB When to Use JAXB JAXB Architecture Developing with JAXB XML-to-Java Mapping The JAXB API Validation with]AXB Customizing JAXB
When to Use Custom Declarations

Advance Topics: Transaction Management Concepts A Transaction Model for Web Services New Transaction Specifications JSRs for Web Service Transaction Support Security, Security Considerations for Web Services Web Services Security Initiatives Canonical XML, XML Digital Signatures Apache XML Security XML Encryption Security Assertions Markup Language Web Services Security Assertions XML Access Control Markup Language XML Key Management Specification WS-I Specifications
SOAP and Firewalls Security and J2EE Java Cryptography Extensions Implementation Scenarios Identity Management Liberty Alliance SourceID Practical Considerations Systems Management Interoperability Pricing Models XMLPay Specification Service Level Agreements Testing Web Services Performance High Availability Scalability
Clustering Fault Tolerance Grid Computing Enabling Services

REFERENCE BOOKS:

1. James McGovern, Sameer Tyagi, "**Michael E. Stevens, Sunil Mathew: Java Web Services Architecture"**, Morgan Kaufmann – 2003.
2. Richard Monsol-Haefel, "**J2EE Web Services"**, Pearson 2003.
3. Steven Graham, Dong Davis, "**Building Web Services with Java"**, II Edition, Pearson-2005.

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10EMS31
HIGH SPEED VLSI DESIGN

Introduction to High speed Digital Design:
Frequency, time and distance, Capacitive and inductive effects. High speed properties of logic gates, speed and power, wire modeling and transmission lines.

Signaling convention and circuits:
Signaling modes for transmission lines, signaling over RC interconnect, driving lossy LC lines, bi-directional signaling, terminators. Signaling Standards, Chip-to-ChipCommunication Networks, ESD Protection

Power distribution and noise:
Power supply network, IR drops, power supply isolation. Noise sources in digital system, cross talk, inter symbol interference.

Timing convention and synchronization:
Timing fundamentals, Clocking Styles, Clock Jitter, Clock Skew, Clock Generation, Clock Distribution, synchronization failure and meta-stability, PLL and DLL based clock aligners. Asynchronous Clocking Techniques.

Clocked & non clocked Logics:
Single-Rail Domino Logic, Dual-Rail Domino Structures, Latched Domino Structures, Clocked Pass Gate Logic, Static CMOS, DCVS Logic, Non-Clocked Pass Gate Families.

Latching Strategies:
Basic Latch Design, and Latching single-ended logic and Differential Logic,
Race Free Latches for Pre-charged Logic Asynchronous Latch Techniques.

REFERENCE BOOKS:

1. Kerry Bernstein & et. al., High Speed CMOS Design Styles, Kluwer, 1999.
2. Evan Sutherland, Bob stroll, David Harris, Logical Efforts, Designing Fast CMOS Circuits, Kluwer, 1999.
3. David Harris, Skew Tolerant Domino Design.
4. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998.
5. Howard Johnson & Martin Graham; High speed Digital Design : A hand book of Black Magic, Prentice Hall PTR, 1993.
6. Jan M. Rabaey , et all; Digital Integrated Circuits: A Design perspective, second dition,2003.

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10LBI31

BIO MEMS AND NANO TECHNOLOGY

Overview and working of MEMS & Microsystems, Micro sensors, Micro actuators, Microsystems design and fabrication

Scaling laws in Miniaturization, Materials for MEMS and Microsystems, Micro manufacturing, LIGA process, Microsystems Design, CAD packages for Microsystems

Introduction to BioMEMS, Microactuators and drug delivery, Emerging BioMEMS technology, Introduction to Nanotechnology, Nano Technology in Biology & Medicine, Nano fabrication towards Biomedical applications.

TEXT BOOKS :

1. Tai Ran Hsu, "**MEMS and Microsystems, Design & Manufacture"**, TMH2002.
2. Mohammed had-el-hak, "**MEMS Introduction & Fundamentals"**, CRC Press.
3. Harisingh Nalwa, "**Nanoscience and Nanotechnology"**, American Scientific Publishers.

REFERENCES :

1. Sergey Edward Lyshevski, "**Nano & MEMS"**, CRC press
2. Nadim Maluf, "**An Introduction to MEMS Engineering"**, Artech House Publishing.
3. Taun-Vo-Dish, "**Nanotechnology in Biology & Medicine methods"**, devices & Applications, CRC

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Group IV

10ECD21
DYNAMICS OF LINEAR SYSTEMS

State Variable Description Of Linear Systems: State space representation of electrical, mechanical and electromechanical systems. Computation of state transition matrix by i) series expansion method, ii) Laplace transform approach and iii) Cayley Hamilton theorem; state space equations in canonical forms; solution of linear time invariant and time variant state equations. Transfer functions.
Controllability and Observability: State variable equations of composite systems, effect of pole zero cancellation subsystems of composite systems, controllability and observability, transformation to the phase variable canonical form.
Design of Control System by State Space Methods: Control system design via pole placement techniques, Design of state observer (full order and minimum order observer); Effects of addition of observer on a closed loop system.
Linear, Discrete, Dynamic Systems Analysis: Introduction, linear difference equations, the discrete transfer function, discrete models of sampled data systems, signal analysis and dynamic response.
Sampled Data Systems: Introduction, analysis of sample and hold circuit, spectrum of sampled signal and aliasing.
State Space Analysis of Discrete Time Systems: State space representation of discrete-time systems solving discrete time state space equations, the pulse-transfer function matrix, discretization of continuous time state space equations, controllability, observability of DT systems..

REFERENCE BOOKS:

1. K. Ogata, "**Modern Control Engineering**".
2. Nagrath and Gopal "**Control System Engineering**".
3. M. K. Chidambara, et.al., "**An Introduction to Control ofDynamic Systems".**
4. G. F. Franklin, "**Digital Control of Dynamic Systems**".
5. K. Ogata, "**Discrete –Time control Systems**".

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10EPS321
ENERGY MANAGEMENT SYSTEMS

States of power system, components of modern energy control center. State Estimation - topology, bad data handling, observability analysis.

Load Prediction - Estimation of average and trend terms, periodic and stochastic components, difference model forecasting.

Economic Load Dispatch: Dispatch of active power by linear programming - simplex, revised simplex and duplex algorithms with comparisons, application of LP techniques for generator dispatch, equal incremental cost techniques, optimum reactive power dispatch.

Load frequency control, automatic generation control - single area and multi area systems, power station control - large scale computer based control schemes.

Voltage stability: analysis, issues and concepts, optimal reactive power control.

REFERENCE BOOKS:

1. Allen J.Wood and Bruce F.Woolenberg, "**Power Generation, Operation, and Control**", John Wiley and Sons, 1984.
2. G.T.Heydt, "**Computer Analysis Methods for Power Systems",** Macmillan Publishing Company, 1986.
3. A.K.Mahalanabis, D.P.Kothari, and S.I.Ahson, "**Computer Aided Power System Analysis and Control**", Tata McGraw Hill Pub. Co., 1992.
4. Torsten Cegrell, "**Power System Control Technology"**, Prentice Hall India, 1986.
5. R.L.Sullivan, "**Power System Planning**", McGraw Hill Inc., 1977
6. George L.Kusic, "**Computer Aided Power System Analysis"**, PHI, 1989.
7. WR Murthy and G Mckay, "**Energy Management",** BSP Publications, Hyderabad.

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10SCE253
ADVANCES IN DIGITAL IMAGE PROCESSING

1. Introduction: Origins of Digital Image Processing, examples, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image analysis and computer vision, spatial feature extraction, transform features, Edge detection, gradient operators, compass operators, stochastic gradients, line and spot detection.

2. Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Zooming and Shrinking Digital Images, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing

3. Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.

4. Image Enhancement in the Frequency Domain: Background, Image Enhancement in the Frequency Domain, Introduction to the Fourier Transform and the Frequency, Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering.

5. Image Restoration: A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations , Estimating the Degradation Function, Inverse Filtering ,Minimum Mean Square Error (Wiener) Filtering.

6. Color Fundamentals: Color Models, Pseudo color Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images, Color Image Compression.

7. Image Transformation: Discrete Cosine Transforms, Walsh Hadmard Transforms, Wavelet Transforms and Multiprocessing, Background, Multiresolution Expansions, Wavelet Transforms in one Dimension, Wavelet Transforms in Two Dimensions, Wavelet Packets, an overview of Second Generation Wavelet Transforms.

8. Image and Video Compression: Fundamentals, Image Compression Models, Lossless compression Methods: Huffman coding, run length coding, LZ coding, Arithmetic coding, Lossy Compression: Gray level Run length coding, Block truncation coding, vector quantization, Differential predictive coding, Transform coding , Hybrid coding, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 .

9. Morphological Image Processing: Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss Transformation, Some Basic Morphological Algorithms.

10. Image Segmentation and Object Recognition: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation, Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.

TEXT BOOKS

1. Rafel C Gonzalez and Richard E. Woods: Digital Image Processing, 3rd Edition, Pearson Education, 2003.
2. Scott.E.Umbaugh: Computer Vision and Image Processing, Prentice Hall, 1997.

REFERENCE BOOKS:

1. A. K. Jain: Fundamentals of Digital Image Processing, Pearson, 2004.
2. Z. Li and M.S. Drew: Fundamentals of Multimedia, Pearson, 2004.
3. S.Jayaraman, S.Esakkirajan, T.Veerakumar: Digital Image Procesing, TataMcGraw Hill, 2004.

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10EC126

REAL TIME OPERATING SYSTEMS

Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems.

System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Esecutive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Reentrant Functions.

Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies.

I/O Resources:
Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture.
Memory:
Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash filesystems.

Multiresource Services:
Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion.

Soft Real-Time Services:
Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services.

Embedded System Components:
Firmware components, RTOS system software mechanisms, Software application components.

Debugging Components:
Execptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics, External test equipment, Application-level debugging.

Performance Tuning:
Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency, Fundamental optimizations.

High availability and Reliability Design:
Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design trade offs, Hierarchical applications for Fail-safe design.

Design of RTOS – PIC microcontroller. **(Chap 13 of book Myke Predko)**

REFERENCE BOOKS:

1. "**Real-Time Embedded Systems and Components" ,** Sam Siewert, Cengage Learning India Edition, 2007.
2. " **Programming and Customizing the PIC microcontroller" ,** Myke Predko, 3rd Ed, TMH, 2008.
3. "**Programming for Embedded Systems**", Dreamtech Software Team, John Wiley, 2008.
4. "**Embedded Linux: Hardware, Software & Interfacing**" , Carig Hollabaugh, Pearson Education, 2009.

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10EPS253
NON-LINEAR AUTOMATIC CONTROL THEORY

Describing Function Analysis*:* Introduction to Nonlinear systems, nonlinear control systems, describing functions, describing function analysis-of NL control systems, generalized describing function, dual input describing function, inverse describing function.

Phase Plane Analysis *:* Introduction, methods for constructing trajectories, obtaining time solutions from phase plane plots, singular points, phase plane analysis of linear control systems, phase plane a analysis of non-linear control systems, point-care index of a singular point, bendixson's criterion, stability definitions of non-linear systems, extension of PP concept to higher order systems,

Numerical Methods: Introduction, Taylor seris expansion method. Modified -Eulers method- Adams "method, Milnes method ; Runge -Kutta method of " least square fit, *Z* form numerical-calculus method, Poincare Perturbation method, An approximation method for second order system.

Lyapunov Stability Analysis: Introduction, definitions, the first method of Lyapunov, second method of Lyapunov, stability analysis of linear systems, stability analysis of non-linear systems, Krasovskis method and variable gradient methods.

Optimal and Adaptive Control Systems*:* Introduction, optimization of an autonomous positioning system with ON-QFF non-linearity, simplified switching of second-order autonomous system, introduction to adaptive systems, input adaptation or response optimization, model adaptive systems.

REFERENCE BOOKS:

1. John E Gibson, "**Non-Linear Automatic Control**, , Mc Graw Hill Publication.
2. Katsuhiko Ogata "**Modern Control Engineering**", Prentice Hall of India.
3. WJ Cunningham, "**Introduction to Non-Linear Analysis**", McGraw Hill Publication.
4. George J, **Analysis and Design of Non-Linear feed Back Control Systems .**

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10EPS252
AI APPLICATIONS IN POWER SYSTEM

Introduction: AI Definitions, history and evolution of AI, essential abilities of intelligence and AI applications.

Problem solving: problem characteristics, problem search strategies, forward and backward reasoning, AND-OR graphs- goal trees, game trees, search methods- informed and uninformed search, breadth first search and depth first search methods.

Knowledge representation: logical formalisms, prepositional and predicate logic, syntax and semantics, wffs, clause form expressions, resolution- use of RRTs for proofs and answers, examples from electric power systems. Non-monotonic logic- TMS, modal, temporal and fuzzy logic.

Structured representation of knowledge: ISA/ISPART trees, associative/ semantic nets, frames and scripts, examples from electric power systems.

Expert system architecture: basic components, rule based systems, forward and backward chaining, ES features, ES development, ES categories, ES tools and examples from electric power systems.

AI Languages: LisP and ProLog - Introduction, sample segments, LisP primitives, list manipulation functions, function predicates, variables, iteration and recursion, property lists, sample programs for examples from electric power systems.

REFERENCE BOOKS:

1. D.W.Patterson, "**Introduction to Artificial Intelligence and Expert Systems"**, Prentice-Hall of India, 1992.
2. Charniak E. and Mcdermott D., "**Introduction to AI**", Addison-Wesley, 1985.
3. Elaine Rich, Kevin Knight, "**Artificial Intelligence"**, Tata McGraw-Hill, 1991.
4. Nils J.Nilson, "**Problem Solving Methods in AI"**, McGraw-Hill, 1971.
5. Nils J.Nilson, "**Principles of AI", Berlin Springer-Verlag**", 1980.

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10EPS31
POWER SYSTEM RELIABILITY ENGINEERING

Basic concepts: adequacy, security, reliability, cost/worth/data, reliability test system (RTS).

System Adequacy Evaluation: RTS, Monte Carlo simulation, contingency enumeration approach, basic distribution systems and reliability assessment;

Assessment of Reliability Worth: interruption costs for commercial, industrial and residential users, interruption energy assessment rate; dependency effects in power system reliability and evaluation of statistical distributions.

REFERENCE BOOKS:

1. Roy Billington, "**Reliability assessment of large electric power systems"**, Kluwer Academic Publishers, USA, 1988,
2. R. Billington and A.N. Allen, "**Reliability evaluation of engineering systems; concepts and techniques**", Longman London/ Plenum press, NY, 1983.
3. Hammersley J.M., Handscomb D.C., "**Monte Carlo Methods**", John Wiley and Sons Inc., NY, 1964.
4. IEEE committee report, IEEE reliability test system, IEEE PAS, Vol. PAS98, 1979, pp 2047-54.

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10EMS323
COMPUTER CONTROL OF INDUSTRIAL DRIVES

Review of Micro controllers in industrial drives system: Typical Micro controller- 8 bit /16 bit (only blockdiagram) Digital Data Acquisition system, voltage sensors, current sensors, frequency sensors and speed sensors.
Evolution of power electronics in drives: Power semiconductors devices used for drives control, GTO, BJT, power MOSFET, IGBT, MCT and IGCT structures, Ratings, comparison and their applications. Block diagram of power integrated circuit for D C motor drives.

A C Machine Drives: general classification and National Electrical Manufacturer Assocition (NEMA) classification, Speed control of Induction motors with variable voltage constant frequency, constant voltage variable frequency, (v/f) constant operation, drive operating regions. Variable stator current operation. Effect of Harmonics.
Synchronous Machine drives: Wound field machine, comparison of Induction and wound field Synchronous machines, Torque angle characteristics of salient pole synchronous machines, synchronous reluctance permanent magnet synchronous machines (SPM), variable reluctance machines (VRM).

Phase controlled converters: Converter controls, Linear firing angle control, cosine wave crossing control, phase locked Oscillator principle, Electrro magnetic Interference (EMI) and line power quality problems, cyclo converters, voltage fed converters, Rectifiers, Current fed converters.

Principals of slip power recovery schemes: Static Kramer's drive system, block schematic diagram, phasor diagram and limitations, Static Scherbius scheme system using D.C link converters with cyclo converter modes of operation, modified Scherbius Drive for variable source, constant frequency (VSCF) generation.
Principle of vector control of A C drives: Phasor diagram, digital Implementation block diagram, Flux vector estimation, indirect vector control block diagram with open loop flux control, synchronous motor control with compensation.
Expert system Application to Drives (only block diagram approach), Expert system shell, Design methodology, ES based P-I tuning of vector controlled drives system. Fuzzy logic control for speed controller in vector control drives, structure of fuzzy control in feedback system.

REFERENCE BOOKS:

1. Bimal K Bose, "Power electronics & motor drives" Elsevier 2006.
2. Bimal K. Bose, "Modern power electronics & drives", Pearson Education 2003.
Badri Ram "Advanced Microprocessor and Interfacing" TMH.

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10SCS23
ADVANCES IN COMPUTER ARCHITECTURE

1. Introduction and Review of Fundamentals of Computer Design: Introduction; Classes computers; Defining computer architecture; Trends in Technology; Trends in power in Integrated Circuits; Trends in cost; Dependability, Measuring, reporting and summarizing Performance; Quantitative Principles of computer design; Performance and Price-Performance; Fallacies and pitfalls; Case studies.

2. Some topics in Pipelining, Instruction –Level Parallelism, Its Exploitation and Limits on ILP: Introduction to pipelining, ILP; Crosscutting issues, fallacies, and pitfalls with respect to pipelining; Basic concepts and challenges of ILP; Case study of Pentium 4, Fallacies and pitfalls. Introduction to limits in ILP; Performance and efficiency in advanced multiple-issue processors.

3. Memory Hierarchy Design, Storage Systems: Review of basic concepts; Crosscutting issues in the design of memory hierarchies; Case study of AMD Opteron memory hierarchy; Fallacies and pitfalls in the design of memory hierarchies. Introduction to Storage Systems; Advanced topics in disk storage; Definition and examples of real faults and failures; I/O performance, reliability measures, and benchmarks; Queuing theory; Crosscutting issues; Designing and evaluating an I/O system – The Internet archive cluster; Case study of NetAA FAS6000 filer; Fallacies and pitfalls.

4. Hardware and Software for VLIW and EPIC

Introduction: Exploiting Instruction-Level Parallelism Statically, Detecting and Enhancing Loop-Level Parallelism, Scheduling and Structuring Code for Parallelism, Hardware Support for Exposing Parallelism: Predicated Instructions, Hardware Support for Compiler Speculation, The Intel IA-64 Architecture and Itanium Processor, Concluding Remarks.

5. Large-Scale Multiprocessors and Scientific Applications

Introduction, Interprocessor Communication: The Critical Performance Issue, Characteristics of Scientific Applications, Synchronization: Scaling Up, Performance of Scientific Applications on Shared-Memory Multiprocessors, Performance Measurement of Parallel Processors with Scientific Applications, Implementing Cache Coherence, The Custom Cluster Approach: Blue Gene/L, Concluding Remarks.

6. Computer Arithmetic

Introduction, Basic Techniques of Integer Arithmetic, Floating Point, Floating-Point Multiplication, Floating-Point Addition, Division and Remainder, More on Floating-Point Arithmetic, Speeding Up Integer Addition, Speeding Up Integer Multiplication and Division, Fallacies and Pitfalls.

TEXT BOOK:

1. Hennessey and Patterson: “Computer Architecture A Quantitative Approach”, 4th Edition, Elsevier, 2007.

REFERENCE BOOK:

1. Kai Hwang: Advanced Computer Architecture - Parallelism, Scalability, Programmability, 2nd Edition, Tata McGraw Hill, 2010.

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10EC060
PATTERN RECOGNITION

Introduction: Applications of pattern recognition, statistical decision theory, image processing and analysis.

Probability: Introduction, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators

Statistical Decision Making: Introduction, Baye's Theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, estimation of error rates, the leaving-one—out technique. Characteristic curves, estimating the composition of populations.

Nonparametric Decision Making: Introduction, histograms, Kernel and window estimators, nearest neighbor classification techniques, adaptive decision boundaries, adaptive discriminate Functions, minimum squared error discriminate functions, choosing a decision making technique.

Clustering: Introduction, hierarchical clustering, partitional clustering

Artificial Neural Networks: Introduction, nets without hidden layers. nets with hidden layers, the back Propagation algorithms, Hopfield nets, an application.

Processing of Waveforms and Images: Introduction, gray level sealing transfoniiations, equalization, geometric image and interpolation, Smoothing, transformations, edge detection, Laplacian and sharpening operators, line detection and template matching, logarithmic gray level sealing, the statistical significance of image features.

REFERENCE BOOKS:

1. Eart Gose, Richard Johnsonburg and Steve Joust, "**Pattern Recognition and Image Analysis**", Prentice-Hall of India-2003.
1. Duda and Hart, "**Pattern recognition (Pattern recognition a scene analysis)**" .
2. Robert J Schalkoff, "**Pattern recognition : Statistical ,Structural and neural approaches**", John Wiley.

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10SSE333
EMBEDDED COMPUTING SYSTEMS

1. Introduction to Embedded Systems: Embedded systems; Processor embedded into a system; Embedded hardware units and devices in a system; Embedded software in a system; Examples of embedded systems; Embedded System-on-Chip (SoC) and use of VLSI circuit design technology; Complex systems design and processors; Design process in embedded system. Formalization of system design; Design process and design examples; Classification of embedded systems; Skills required for an embedded system designer.
2. Devices: I/O types and examples; Serial communication devices; Parallel device ports; Sophisticated interfacing features in device ports. Wireless devices; Timer and counting devices; Watchdog timer; Real time clock.
3. Communication Buses for Device Networks: Networked embedded systems; Serial bus communication protocols; Parallel bus device protocols; Internet enabled systems; Wireless and mobile system protocols.
4. Device Drivers and Interrupts Service Mechanism: Device access without interrupts; ISR concept; Interrupt sources; Interrupt servicing mechanism; Multiple interrupts; Context and the periods for context-switching, interrupt latency and deadline; Classification of processors' interrupt service mechanism from context-saving angle; Direct memory access; Device drivers programming.
5. Program Modeling Concepts, Processes, Threads, and Tasks: Program models; DFG models; State machine programming models for event controlled program flow; Modeling of multiprocessor systems.
Multiple processes in an application; Multiple threads in an application; Tasks and task states; Task and data; Distinctions between functions, ISRs and tasks.
6. Real-time Operating systems: Operating System services; Process management; Timer functions; Event functions; Memory management; Device, file and I/O sub-systems management; Interrupt routines in RTOS environment and handling of interrupt source calls. Real-Time Operating Systems; Basic design using an RTOS; RTOS task scheduling models, interrupt latency and response times of the tasks as performance metrics; OS security issues.
7. Embedded Software Development, Tools: Introduction; Host and target machines; Linking and locating software; Getting embedded software in to the target system; Issues in hardware software design and co-design; Testing on host machine; Simulators; Laboratory tools.

TEXT BOOKS:
1. Rajkamal: Embedded Systems Architecture, Programming and Design, 2nd Edition, Tata McGraw Hill, 2008.

REFERENCE BOOKS:
1. Wayne Wolf: Computers as Components Principles of Embedded Computer System Design, 2nd Edition, Elsevier, 2008.
2. Steve Heath: Embedded Systems Design, 2nd Edition, Elsevier, 2003.
3. Dr. K.V.K.K. Prasad: Embedded/Real-Time Systems: Concepts, Design and Programming – The Ultimate Reference, Dreamtech Press/Wiley India, 2007.
4. Michael J.Point: Embedded C, Pearson, 2002..

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10SCE252
DATA WAREHOUSING AND DATA MINING

1. Data Warehousing – Introduction: Operational Data Stores (ODS), Extraction Transformation Loading (ETL), Data Warehouses Design Issues, Guidelines for Data Warehouse Implementation, Data Warehouse Metadata.
2. Online Analytical Processing (OLAP): Introduction, Characteristics of OLAP systems, Multidimensional view and Data cube, Data Cube Implementations, Data Cube operations, Implementation of OLAP and overview on OLAP Softwares.
3. Data Mining: Introduction, Challenges, Data Mining Tasks, Types of Data, Data Preprocessing, Measures of Similarity and Dissimilarity, Data Mining Applications
4. Association Analysis - Basic Concepts and Algorithms: Frequent Itemset Generation, Rule Generation, Compact Representation of Frequent Itemsets, Alternative methods for generating Frequent Itemsets, FP Growth Algorithm, Evaluation of Association Patterns
5. Classification: Basics, General approach to solve classification problem, Decision Trees, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers, Estimating Predictive accuracy of classification methods, Improving accuracy of clarification methods, Evaluation criteria for classification methods, Multiclass Problem.
6. Clustering Techniques: Overview, Features of cluster analysis, Types of Data and Computing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis
7. Web Mining: Introduction, Web content mining, Text Mining, Unstructured Text, Text clustering, Mining Spatial and Temporal Databases.

TEXT BOOKS:
1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar: Introduction to Data Mining, Pearson Education, 2007.
2. G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI Learning, 2009.

REFERENCE BOOKS:
1. Arun K Pujari: Data Mining Techniques, 2nd Edition, Universities press, 2009.
2. Jiawei Han and Micheline Kamber: Data Mining - Concepts and Techniques, 2nd Edition, Morgan Kaufmann Publisher, 2006.
3. Alex Berson and Stephen J. Smith: Data Warehousing, Data Mining, and OLAP Computing, Mc Graw Hill Publisher, 1997.

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10SCS321
WIRELESS AND CELLULAR NETWORKS

1. Introduction to Wireless Communication Systems: Evolution of Mobile Radio Communications Mobil Radio Systems around the world examples of Wireless Communication Systems, Paging System, Cordless Telephone System. Cellular Telephone Systems, Comparison of Common Wireless Communications Systems.
2. Modern Wireless Communications Systems: Second generation (2G), Cellular Networks, evolution of 2.5G, TDMA Standards, Third Generation (3G) Wireless Networks, Wireless Local Loop (WLL) and LMDS, Wireless Local Area Networks (WLANs), Bluetooth and Personal Area Networks (PANS)
3. The Cellular Concept: System Design Fundamentals, Introduction, Frequency reuse, channel assignment strategies, handoff strategies – prioritizing handoffs, Practical Handoff considerations. Interference and system capacity, co-channel interference and system capacity, channel planning for wireless systems, adjacent channel interference, power control for reducing interference.
4. Mobile Radio Propagation: Introduction to radio wave propagation, Free space propagation model, Relating power to electric field, Reflection, Diffraction, Scattering.
5. Modulation Techniques for Mobile Radio: Frequency modulation Vs amplitude modulation, Amplitude modulation, Angle modulation, Digital Modulation, Linear Modulation techniques – Binary phases shift keying (BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), Constant envelope modulation – Binary Frequency Shift Keying, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK).
6. Multiple Access Techniques for Wireless Communications: Introduction to Multiple access, Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Spread Spectrum Multiple Access, Space Division Multiple Access (SDMA), Packet Radio. Protocols, Reservation Protocols – Reservation ALOHA, Packet Reservation Multiple Access (PRMA), Capacity of cellular systems.
7. Wireless Networking: Introduction, Difference between Wireless and Fixed Telephone Networks, Development of Wireless Networks, First generation, second generation, third generation.

TEXT BOOKS:
1. Theodore S Rappaport**:** Wireless Communications, Principles and Practice, 2nd Edition, Pearson Education Asia, 2002.

REFERENCE BOOKS:
1. William C Y Lee: Mobile Communications Engineering Theory and Applications, 2nd Edition, McGraw Hill, 1998.
2. William Stallings: Wireless Communications and Networks, Pearson Education Asia, 2002.

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10SSE153
COMPUTER SYSTEMS PERFORMANCE ANALYSIS

1. Introduction: The art of Performance Evaluation; Common Mistakes in Performance Evaluation, A Systematic Approach to Performance Evaluation, Selecting an Evaluation Technique, Selecting Performance Metrics, Commonly used Performance Metrics, Utility Classification of Performance Metrics, Setting Performance Requirements.
2. Workloads, Workload Selection and Characterization: Types of Work loads, addition instructions, Instruction mixes, Kernels; Synthetic programs, Application benchmarks, Popular benchmarks. Work load Selection: Services exercised, level of detail; Representativeness; Timeliness, Other considerations in workload selection. Work load characterization Techniques: Terminology; Averaging, Specifying dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.
3. Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.
4. Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote-Terminal Emulation; Components of an RTE; Limitations of RTEs.
5. Experimental Design and and Analysis: Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2^k Factorial Designs, Concepts, Computation of effects, Sign table method for computing effects; Allocation of variance; General 2^k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.
6. Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little's Law, Types of Stochastic Process. Analysis of Single Queue: Birth-Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little's Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis; Approximate MVA; Balanced Job Bounds; Convolution Algorithm, Distribution of Jobs in a System, Convolution Algorithm for Computing G(N), Computing Performance using G(N), Timesharing Systems, Hierarchical Decomposition of Large Queuing Networks: Load Dependent Service Centres, Hierarchichal Decomposition, Limitations of Queuing Theory.

TEXT BOOK:
1. Raj Jain: The Art of Computer Systems Performance Analysis, John Wiley and Sons, 2007.

REFERENCE BOOKS:
1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, Elsevier, 2003.
2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 2nd Edition, Wiley India, 2001.

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10EC093
MODERN SPECTRAL ANALYSIS & ESTIMATION

Basic Concepts: Introduction, Energy Spectral Density of deterministic signals, Power Spectral Density of random signals, properties of Power Spectral Densities, The Spectral Estimatuion problem, Coherence Spectrum.

Spectrum Estimation: Introduction, Correlogram method, Periodogram Computation Via FFT, properties of Periodogram method such as bias analysis, window design considerations. Signals with Rational spectra. ARMA state – space Equation, sub space Parameter Estimation.

Parametric Methods for line Spectra: Models of sinusoidal Signals in Noise, Non-linear least squares method. High Order Yule Walker method, Min – Norm Method, ESPRIT Method, Forward – Backward Estimatuion.

Filter Bank Method: Filter bank Interpretation of the period gram, Refined Filter bank Method, Capon Method, Filter Bank Reinterpretation of the periodogram.

Optimum Linear Filter : Optimum Signal Estimation, Linear MSE Estimation, Solution of the normal equations optimum FIR and IIR filters. Inverse filtering and deconvolution.

REFERENCE BOOKS:

1. Stoica and Moses, "**Introduction to Spectral Analysis**", PHI, 1997.
2. Monalakis, Ingle and Kogen, "**Stastical and Adaptive Signal Procedssing**", Tata McGraw Hill. 2000.

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10EPE153
ELECTRICAL MACHINE DYNAMICS

Dynamic Equation of Motion: Electro mechanical systems-Analytical techniques, Transducers-physical systems, Fundamentals of systems dynamics.
Lagrange's Equations: Applications of Lagrange's equation to electro mechanical system, Solution of electro dynamical equations, Euler's method, Runge-Kutta method.

Generalized Machine Concepts: KRON's machine, performance equation, dynamic variables, machines with uniform gap, machines with Saliency.

Dynamics of Machines: Commutator machines-induction machines-synchronous machines-small oscillations-synchronous machine equation during small oscillations, general equations for small oscillations, representation of the oscillation equations in state variable form. Generalized analysis of N-M winding machines

REFERENCE BOOKS:

1. Adkins "**Generalized Theory of Machines**".
2. D.P.Sen Gupta and J.W.Lynn "**Generalized Theory of Machines**".
3. Seely "**Electro Mechanical Energy Conversion**".
4. P. C. Krause, "**Analysis of Electrical Machines**", MGH, 1987.
5. P. C. Krause, Oleg Wasynesuk, Scolt D Sudhoff, "**Analysis of Electrical Machinery and Drive System**", MGH, 2nd Edition, 2002.

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10EC127
RF MEMS

Review – Introduction to MEMS. Fabrication for MEMS, MEMS transducers and Actuators . Microsensing for MEMS, Materials for MEMS.
MEMS materials and fabrication techniques – Metals, Semiconductors, thin films, Materials for Polymer MEMS, Bulk Machining for silicon based MEMS, Surface machining for Silicon based MEMS, Micro Stereo Lithography for Polymer MEMS.

RF MEMS Switches and micro – relays. Switch Parameters, Basics of Switching, Switches for RF and microwave Applications , Actuation mechanisms, micro relays and micro actuators, Dynamics of Switch operation, MEMS Switch Design and design considerations. MEMS Inductors and capacitors.

Micromachined RF Filters and Phase shifters. RF Filters, Modeling of Mechanical Filters, Micromachanical Filters, SAW filters – Basics, Design considerations. Bulk Acoustic Wave Filters, Micromachined Filters for Millimeter Wave frequencies. Micromacbined Phase Shifters, Types and Limitations, MEMS and Ferroelectric Phase shifters, Applications.

Micromachined transmission lines and components. Micromachined Transmission Lines – Losses in Transmission lines, coplanar lines, Meicroshield and membrane supported lines, Microshield components, Micromachined waveguides, directional couplers and mixers, Resonators and Filters.

Micomachined antennas. Design, Fabrication and Measurements.
Integration and Packaging for RF MEMS. Roles and types of Packages, Flip Chip Techniques, Multichip module packaging and Wafer bonding, Reliability issues and Thermal issues.

REFERENCE BOOKS:

1 RF MEMS – V K Varadan, A Laktakia and K J Vinoy, John Wiley, 2003 Reprint.
2. RF MEMS Circuit Design J De Los Santos, Artech House, 2002.
3. Transaction Level Modeling with SystemC: TLM Concepts and Applications for Embedded Systems, by Frank Ghenassia, Springer, 2005.
5. Networks on Chips: Technology and Tools, by Luca Benini and Giovanni De Micheli , Morgan Kaufmann Publishers, 2006.

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10EPE23
POWER ELECTRONICS SYSTEM DESIGN USING ICs

Introduction: Measurement Techniques for Voltages, Current, Power, power factor in Power Electronic circuits, other recording and analysis of waveforms, sensing of speed.

Switching Regulator Control Circuits : Introduction, Isolation Techniques of switching regulator systems, PWM Systems, Some commercially available PWM control ICs and their applications: TL 494 PWM Control IC, UC 1840 Programmable off line PWM controller, UC 1524 PWM control IC, UC 1846 current mode control IC, UC 1852 Resonant mode power supply controller.

Switching Power Supply Ancillary, Supervisory & Peripheral circuits and components: Introduction, Optocouplers, self Biased techniques used in primary side of reference power supplies, Soft/Start in switching power supplies, Current limit circuits, Over voltage protection, AC line loss detection.

Phase – Locked Loops (PLL) & Applications:PLL Design using ICs, 555 Timer & its applications, Analog to Digital converter using ICs, Digital to Analog converters using ICs, implementation of different gating circuits.

Programmable Logic Controllers (PLC): Basic configuration of a PLC, Programming and PLC, Program Modification, Power Converter control using PLCs.

REFERENCE BOOKS:

G. K. Dubey, S. R. Doradla, A. Johsi, and R. M. K. Sinha, "**Thyristorised Power Controllers**", New Age International, 1st Edition, 2004.

George Chryssis "**High Frequency Switching Power Supplies**", MGH, 2nd Edition,

Unitrode application notes: http://www.smps.us/Unitrode.html

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10EC025
DESIGN OF ANALOG & MIXED MODE VLSI CIRCUITS

Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models.

Single stage Amplifier: CS stage with resistance load, divide connected load, current source load, triode load, CS stage with source degeneration, source follower, common-gate stage, cascade stage, choice of device models.

Differential Amplifiers: Basic difference pair, common mode response, Differential pair with MOS loads, Gilbert cell.

Passive and active Current mirrors: Basic current mirrors, Cascade mirrors, active current mirrors.

Frequency response of CS stage: source follower, Common gate stage, Cascade stage and Difference pair. Noise in CS stage, C- G stage, source follower, cascade stage, differential pair.

Operational Amplifiers: One Stage OP-Amp. Two Stage OP-Amp, Gain boosting, Coommon Mode Feedback, Slew rate, PSRR. Compenastion of 2stage OP-Amp, Other compensation techniques.

Oscillators: Ring Oscillators, LC Oscillators, VCO, Mathematical Model of VCO.

PLL: Simple PLL, Charge pump PLL, Non-ideal effects in PLL, Delay locked loops and applications.

Bandgap Refernces and Switched capacitor filetrs.

REFERENCE BOOK:

"**Design of Analog CMOS Integrated Circuits**", Behzad Razavi, TMH, 2007.

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10EC086
WIRELESS COMMUNICATIONS

Wireless channel: physical modeling for wireless channels, input/output model of wireless channel, time and frequency response, statistical models.

Point to point communication: detection in rayleigh fading channel, time diversity, antenna diversity, frequency diversity, impact of channel uncertainity.

Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear time invariant gaussian channels, capacity of fading channels.

MIMO 1 – Spatial multiplexing and channel modeling: multiplexing capability of MIMO channels, physical modeling of MIMO channels, modeling MIMO fading channels. MIMO II – Capacity and multiplexing architectures: V-BLAST, fading MIMO channel, receiver architectures, slow fading MIMO channel, D-BLAST. **MIMO III –** Diversity multiplexing tradeoff, universal code design.

REFERENCE BOOKS:

1. David Tse, P. Viswanath, "**Fundamentals of wireless communication**", Cambridge, 2006.
2. Andreas Molisch, "**Wireless communications**", Wiley, 2009.
   William C Y Lee, "**Mobile Communication Engineering Theory and applications"**, TMGH, 2008.
3. Upen Dalal, "**Wireless communication"**, Oxford, 2009.
6 Mark Ciampa, Jorge Olenwa, "**Wireless communications"**, Cengage, 2007.

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10LBI253
BIOSENSORS

Introduction : What are Biosensors? Advantages and limitations, various components of biosensors, the growing of biosensor. The biosensor family, the biomolecule ingredients, proteins, enzymes complexes, enzymes kinetics, the proteins of the immune systems.

Transducers in Biosensors : Various types of transducers; principles and applications - Calorimetric, optical, potentiometric / amperometric conductrometric/resistormetric, piezoelectric, semiconductor, impedimetric, mechanical and molecular electronics based transducers. Chemiluminescences - based biosensors.

Application and Uses of Biosensors: Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food. Biosensors for personal diabetes management, application of biosensors to environmental samples. Biochips and their application to genomics.

Semiconductor Electrodes : Measurement of H +**,** Ion selective interfaces, Ion selective electrodes, semiconductor electrodes, MIS structures, semiconductor solution interface, FET, chemical sensitive FETA (CHEMFETA), suspended gate field effect transistor, selectivity via pattern recognition, Ion selective FET (ISFET), reference FET, CHEMFET, assessment of CHEMFETS.

Amperometric Assay Techniques : Analysis of charge transfer, volumetric techniques, potential step techniques, non steady state measurement, and applications of charge transfer measurement of the oxygen electrode.
Source of error – Depletion of sample, non-Faradic current error, selectivity interference from other electro active species, Amperometric electrodes for estimation of Ion concentration, macromolecules system, Redox enzymes, modified electrodes, mediated electron transfer, microelectrode fabrication and application.

Photometric Assay Techniques : Energy transition, ultraviolet and visible absorption spectra, fluorescence and phosphorescence, infra Red transitions, light scattering, Raman scattering, applications of ultraviolet visible spectra, indicator linked bioassay, irrational spectroscopy, the optical transducer, wave guides in sensors, device construction, P^H optical probes, light scattering analysis.

Optical Biosensors & Other Techniques: Indicator labeled bioassay, chemiluminescence, bioluminescence, surface plasma resonance, piezoelectric based sensors and surface acoustic waves.

TEXTBOOKS:

1. **"Biosensors**" Elizabeth A. H Hall - Open University press, Milton Keynes.
2. **"Commercial Biosensors"** Graham Ramsay, John Wiley and son, INC. (1998).

REFERENCES:

1. **"Biosensors edited by AEG CASS"** – OIRL press, Oxford University.
2. **"Transducers and Instrumentation",** Murthy D V S. Prentice Hall, 1995

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10EC047
LOW POWER VLSI DESIGN

Introduction : Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices.

Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation

Power estimation, Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.

Probabilistic power analysis: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy.

Low Power Design Circuit level: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library
Logic level: Gate reorganization, signal gating, logic encoding, state machine encoding, pre-computation logic

Low power Architecture & Systems: Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design.

Low power Clock Distribution: Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network

Algorithm & Architectural Level Methodologies: Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

REFERENCE BOOKS:

1. Kaushik Roy, Sharat Prasad, "**Low-Power CMOS VLSI Circuit Design**" Wiley, 2000.
2. Gary K. Yeap, "**Practical Low Power Digital VLSI Design**", KAP, 2002.
3. Rabaey, Pedram, "**Low Power Design Methodologies**" Kluwer Academic, 1997.

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10EC077
SYNTHESIS AND OPTIMIZATION OF DIGITAL CIRCUITS

Introduction: Microelectronics, semiconductor technologies and circuit taxonomy, Microelectronic design styles, computer aided synthesis and optimization.

Graphs: Notation, undirected graphs, directed graphs, combinatorial optimization, Algorithms, tractable and intractable problems, algorithms for linear and integer programs, graph optimization problems and algorithms, Boolean algebra and Applications.

Hardware Modeling: Hardware Modeling Languages, distinctive features, structural hardware language, Behavioral hardware language, HDLs used in synthesis, abstract models, structures logic networks, state diagrams, data flow and sequencing graphs, compilation and optimization techniques.

Two Level Combinational Logic Optimization: Logic optimization, principles, operation on two level logic covers, algorithms for logic minimization, symbolic minimization and encoding property, minimization of Boolean relations.

Multiple Level Combinational Optimizations: Models and transformations for combinational networks, algebraic model, Synthesis of testable network, algorithm for delay evaluation and optimization, rule based system for logic optimization.
Sequential Circuit Optimization: Sequential circuit optimization using state based models, sequential circuit optimization using network models.
Schedule Algorithms: A model for scheduling problems, Scheduling with resource and without resource constraints, Scheduling algorithms for extended sequencing models, Scheduling Pipe lined circuits.

Cell Library Binding: Problem formulation and analysis, algorithms for library binding, specific problems and algorithms for library binding (lookup table F.P.G.As and Antifuse based F.P.G.As), rule based library binding.

Testing: Simulation, Types of simulators, basic components of a simulator, fault simulation Techniques, Automatic test pattern generation methods (ATPG), design for Testability (DFT) Techniques.

REFERENCE BOOKS:

1. Giovanni De Micheli, "**Synthesis and Optimization of Digital Circuits**," Tata McGraw-Hill, 2003.
2. Srinivas Devadas, Abhijit Ghosh, and Kurt Keutzer, "**Logic Synthesis**," McGraw-Hill, USA, 1994.
3. Neil Weste and K. Eshragian, "**Principles of CMOS VLSI Design: A System Perspective**," 2nd edition, Pearson Education (Asia) Pte. Ltd., 2000.
4. Kevin Skahill, "**VHDL for Programmable Logic**," Pearson Education (Asia) Pte. Ltd., 2000.

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10EC075
SPEECH AND AUDIO PROCESSING

Digital Models For The Speech Signal: Process of speech production, Acoustic theory of speech production, Lossless tube models, and Digital models for speech signals.

Time Domain Models for Speech Processing: Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.

Digital Representations of the Speech Waveform: Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.

Short Time Fourier Analysis: Linear Filtering interpretation, Filter bank summation method, Overlap addition method, Design of digital filter banks, Implementation using FFT, Spectrographic displays, Pitch detection, Analysis by synthesis, Analysis synthesis systems.

Homomorphic Speech Processing: Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder.

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications.

Speech Enhancement: Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation.

Speech Synthesis: Principles of speech synthesis, Synthesizer methods, Synthesis of intonation, Speech synthesis for different speakers, Speech synthesis in other languages, Evaluation, Practical speech synthesis.

Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks.

Audio Processing: Auditory perception and psychoacoustics - Masking, frequency and loudness perception, spatial perception, Digital Audio, Audio Coding - High quality, low-bit-rate audio coding standards, MPEG, AC-3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound.

REFERENCE BOOKS:

1. L. R. Rabiner and R. W. Schafer**,** "**Digital Processing of Speech Signals**", Pearson Education (Asia) Pte. Ltd., 2004.
2. D. O'Shaughnessy, "**Speech Communications: Human and Machine**", Universities Press, 2001.
3. L. R. Rabiner and B. Juang, "**Fundamentals of Speech Recognition**", Pearson Education (Asia) Pte. Ltd., 2004.

Z. Li and M.S. Drew**,** "**Fundamentals of Multimedia**", Pearson Education (Asia) Pte. Ltd., 2004.

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10EC055
. NET TECHNOLOGY

•**Net Framework:** The Architecture of.Net Framework Development Platform, Building, Packaging, Deploying, and Administering Applications and types Shared Assemblies

Common Language Runtime: Type Fundamental Primitive, Reference and Value Types Common Object Operations Type Members Constants and Fields Methods Properties Events Working with Text Enumerated Types and Bit Flags Arrays Interfaces Custom Attributes Delegates Exceptions Automatic Memory Management CLR Hosting AppDomains Refletion

Language Fundamentals: Introduction to C# Expressions and Control Structures Strings and Regular Expressions Arrays and Collections Objects and Classes File and Stream I/O and Object Persistence XML Fundamentals Multithreaded Programming Events and Delegates Reflection and Code Attributes Assemblies and AppDomains COM and Windows Interoperability High Performance Programming

Applications: Introduction to Windows Forms, Windows Forms User Interface Controls, Creating Visually Compelling Windows Forms Applications Consuming Web Services Smart Clients Deploying Windows Applications, Introduction to Web Forms and ASP•NET Web UI Controls State Management in ASP•NET Caching Advanced ASP•NET Deploying ASP•NET Applications Using •NET Data Providers Creating a Custom ADO•NET Data Provider Typed DataSets and XSD Windows Forms Data Binding Web Forms Data Binding Introduction to Web Services Using WSE 2.0 ode Access Security Securing Sensitive Data Securing ASP•NET Web Applications Licensing and Intellectual Property Interface Programming Remoting COM+ Enterprise Services Enterprise Templates

REFERENCE BOOKS:

1. Jeffery Richter: "**Applied Microsoft •NET Framework programming**", WP Publishers 2003.
2. Kevin Hoofman, Lonny Kruger: "**Microsoft Visual C# •NET**", 2003, Pearson 2005.
3. Angshuman Chakraborti, "**Miscrosoft •NET Framework**", PHI 2002.

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10EC071
RF AND MICROWAVE CIRCUIT DESIGN

Wave Propagation in Networks: Introduction to RF/Microwave Concepts and applications; RF Electronics Concepts; Fundamental Concepts in Wave Propagation; Circuit Representations of two port RF/MW networks

Passive Circuit Design: The Smith Chart, Application of the Smith Chart in Distributed and lumped element circuit applications, Design of Matching networks.

Basic Considerations in Active Networks: Stability Consideration in Active networks, Gain Considerations in Amplifiers, Noise Considerations in Active Networks.

Active Networks: Linear and Nonlinear Design: RF/MW Amplifiers Small Signal Design, Large Signal Design, RF/MW Oscillator Design, RF/MW Frequency Conversion Rectifier and Detector Design, Mixer Design, RF/MW Control Circuit Design, RF/MW Integrated circuit design.

REFERENCE BOOKS:

1. Matthew M. Radmanesh**,** "**Radio Frequency and Microwave Electronics Illustrated"**, Pearson Education (Asia) Pte. Ltd., 2004.
2. Reinhold Ludwig and Pavel Bretchko, "**RF Circuit Design: "Theory and Applications**", Pearson Education (Asia) Pte. Ltd., 2004.
D K Mishra, "**RF Circuit Design**", John Wiley, Intl.

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10EPE333
DSP APPLICATIONS TO POWER ELECTRONICS

Introduction to the TMS320LF2407 DSP Controller, C2xx DSP CPU Architecture and Instruction Set, General Purpose Input/output (GPIO) Functionality, Interrupts on the TMS320LF2407, Analog-to-Digital Converter (ADC) , Event Managers (EVA, EVB) .
DSP-Based applications of DC-DC Buck-Boost Converters, DSP based Control of Stepper Motors, DSP-Based Control of Permanent Magnet Brushless DC Machines, Park and Clarke's Transformations, Space Vector Pulse Width Modulation, DSP-Based Control of Permanent Magnet Synchronous Machines, DSP-Based Vector Control of Induction Motors.

Reference BOOKS:
Hamid Toliyat and Steven Campbell, “DSP-Based Electromechanical Motion Control”, CRC Press, 2004.

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10EC059
OPTICAL COMMUNICATION & NETWORKING

Introduction: Propagation of signals in optical fiber, different losses, nonlinear effects, solitons, optical sources, detectors.
Optical Components: Couplers, isolators, circulators, multiplexers, filters, gratings, interferometers, amplifiers.

Modulation — Demodulation: Formats, ideal receivers, Practical detection receivers, Optical preamplifier, Noise considerations, Bit error rates, Coherent detection.

Transmission System Engineering: system model, power penalty, Transmitter, Receiver, Different optical amplifiers, Dispersion.
Optical Networks: Client layers of optical layer, SONET/SDH, multiplexing, layers, frame structure, ATM functions, adaptation layers, Quality of service and flow control, ESCON, HIPPI.

WDM Network Elements: Optical line terminal optical line amplifiers, optical cross connectors, WDM network design, cost trade offs, LTD and RWA problems, Routing and wavelength assignment, wavelength conversion, statistical dimensioning model.

Control and Management: network management functions, management frame work, Information model, management protocols, layers within optical layer performance and fault management, impact of transparency, BER measurement, optical trace, Alarm management, configuration management.

Suitable number of Assignments / Tutorials can be given based on the syllabus.

REFERENCE BOOKS:

1. John M. Senior, "**Optical Fiber Communications**", Pearson edition, 2000.
2. Rajiv Ramswami, N Sivaranjan, "**Optical Networks**", M. Kauffman Publishers, 2000.
3. Gerd Keiser, "**Optical Fiber Communication**", MGH, 1 991.
4. G. P. Agarawal, "**Fiber Optics Communication Systems**", John Wiley NewYork, 1997
5. P.E. Green, "**Optical Networks**", Prentice Hall, 1994.

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