Biju Patnaik University of Technology, Orissa

M.Tech Syllabus

in

Computer Science & Engineering

From
2009 -2010 Academic Session

Analysis and Design of Algorithm

UNIT-1

Algorithm paradigms, Asymptotic notations, Recurrences, Divide and conquer (Merge sort, Heap sort, Quick sort and its correctness proofs) Lower bounds of sorting, Counting sort.

UNIT-II

Randomization (Randomization quick sort, Primality testing), Dynamic Programming (Floyd-Warshall Algorithm, Longest Common Subsequence, Matrix chain multiplication), Greedy Method (Single source shortest path, M, Knapsack problem, Minimum cost spanning trees, Task scheduling),

UNIT- III

Polynomial time, Polynomial-time verification, NP completeness and reducibility, NP completeness proofs,, Cook's theorem, NP complete problem

UNIT – IV

Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm), Internet algorithm (text pattern matching, tries, Ukonnen's algorithm).

Books:

1. Michael Goodrich and Roberto Tamassia, "Algorithm Design", John Wiley & Sons, 2002.
2. Mark Allen Weiss, "Data Structures & Algorithm Analysis in C/C++", Pearson Edu. India.
3. T. H. Cormen, C. E. Leiserson, and R. L. Rivest, " Introduction to Algorithms", PHI.
4. Horowitz, Sahni, Rajasekaran, "Fundamentals of Computer Algorithms", Galgotia publ., 1999.

ADVANCED COMPUTER ARCHITECTURE

Introduction: Review of basic computer architecture, quantitative techniques in computer design, measuring and reporting performance;

CISC and RISC processors, Pipelining: Basic concepts, instructions and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards, Exception handling, pipeline optimization techniques;

Hierarchical memory technology: Inclusion, Coherence and locality properties, cache memory organizations, techniques for reducing cache misses, virtual memory organization, mapping and management techniques, memory replacement policies;

Instruction-level parallelism: basic concepts, techniques for increasing ILP, super-scalar, super-pipelined and VLIW processor architectures, array and vector processors;

Multiprocessor architecture: Taxonomy of parallel architectures;

Centralized shared-memory architecture: Synchronization, memory consistency, interconnections networks, Distributed shared-memory architecture, cluster computers.

Books:

1. Henessy and Patterson, "Computer Architecture—A Quantitative Approach", Pearson press, 3rd Edition, 2003.
2. K.Hwang and F.A.Briggs, "Computer Architecture and Parallel Processing", Mc-Graw Hill, 1984.
3. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, programmability", Mc-Graw Hill,
4. M.Singhal and N.G.Sivaratri, "Advanced concepts of Operating Systems", Tata-Mc-Graw Hill Publication, 2001.
5. Crowley, "Operating Systems".

OBJECT ORIENTED SYSTEM

UNIT-1

Real world domains, object oriented approach and technology, objects instances and concepts, Objects and classes of objects, generalized object oriented software, Development cycle, Object oriented programming language, object-oriented analysis of a real world domain object model. The notation of encapsulation and information hiding, object identity: entity and attributes, data and knowledge: The notion of inheritance, Relationship between objects: Association, Generalization/ Specialization, Aggregation, Object and States, Dynamic behavior of objects.

UNIT-II

Object-Oriented analysis: introduction, Techniques for information gathering for RA, use case driven object oriented analysis, concepts and principles, identifying the elements of an object model, Management of Object-Oriented Software projects, Object oriented analysis, domain analysis and generic components of object- oriented analysis model, object behavior model.

The intent of object-oriented metrics, the distinguishing characteristics and metrics for the object-oriented design model, class oriented metrics, operation oriented metrics, metrics for object oriented testing, metrics for object-oriented projects.

UNIT-III

Introduction to UML : The meaning of object-orientation, object identity, encapsulation, information hiding, polymorphism, genericity, importance of modeling, principles of modeling, object oriented modeling, conceptual modeling of the UML, Architecture.

Basic structural modeling : classes, relationships, common mechanisms, diagrams, advanced structural modeling : advanced relationship interfaces, roles, packages, instances.

UNIT-IV

Class & object diagrams: Terms, concepts, examples, modeling techniques, class & object diagrams. Collaboration Diagrams: Terms, Concepts, depicting a message, polymorphism in collaboration diagrams, iterated messages, use of self in messages. Sequence diagrams: Terms, concepts, differences between collaboration and sequence diagrams, depicting synchronous messages with/without priority call back mechanism broadcast message.

UNIT-V

Behavioral modeling: interactions, use cases, use case diagrams, activity diagrams. Advanced Behavioral modeling: Events and signals, state machines, process and threads, time and space, state chart diagram. Architectural Modeling: Terms, concepts, examples, modeling techniques for component diagrams and deployment diagram

Suggested Reading:

1. Grady Boach, James Rambaugh, Ivar Jacobson : The unified modeling language user gude, Addison wesey.
2. Mieiar Page-jones : fundamentals of object oriented design in UML, Addison Wesley, 2000
3. Larmen

Professional Electives (Any Two)

Real Time Systems

UNIT-1 **[10Hrs]**

Introduction: What is real time, Applications of Real-Time systems, A basic model of Real-time system, Characteistics of Real-time system, Safety and Reliability, Types of Real-time tasks, timing constraints, Modelling timing constraints

Real-Time Task Scheduling: Some important concepts, Types of Real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Some issues Associated with RMA. Issues in using RMA practical situations.

UNIT-2 **[10Hrs]**

Handling Resource Sharing and dependencies among Real-time Tasks: Resource sharing among real-time tasks. Priority inversion. Priority Inheritance Protocol (PIP), Highest Locker Protocol (HLP). Priority Ceiling Protocol (PCP). Different types of priority inversions under PCP.Important features of PCP. Some issues in using a resource sharing protocol. Handling task dependencies.

Scheduling Real-time tasks in multiprocessor and distributed systems: Multiprocessor task allocation, Dynamic allocation of tasks. Fault tolerant scheduling of tasks. Clock in distributed Real-time systems, Centralized clock synchronization

UNIT-3 **[5Hrs]**

Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix as a Real-time operating system, Unix-based Real-time operating systems, Windows as a Real-time operating system,POSIX, A survey of contemporary Real-time operating systems. Benchmarking real-time systems.

Real-time Databases: Example applications of Real-time databases. Review of basic database concepts, Real-time databases, Characteristics of temporal data. Concurrency control in real-time databases. Commercial real-time databases.

UNIT-4 **[5Hrs]**

Real-time Communication: Examples of applications requiring real-time communication, Basic concepts, Real-time communication in a LAN. Soft Real-time communication in a LAN. Hard real-time communication in a LAN. Bounded access protocols for LANs. Performance comparison, Real-time communication over packet switched networks. Qos framework, Routing, Resource reservation, Rate control, Qos models.

Books:

1. Real-time Systems Theory and Practice by Rajib Mall, Pearsons Publication.

Computational Intelligence

Introduction to Soft Computing: Soft computing constituents and conventional Artificial Intelligence, Neuro-Fuzzy and Soft Computing characteristics.
Fuzzy Sets, Fuzzy Rules and Fuzzy Reasoning: Introduction, Basic definitions and terminology, Set-theoretic operations, MF Formulation and parameterization, More on fuzzy union, intersection, and complement, Extension principle and fuzzy relations, Fuzzy If-Then rules, Fuzzy reasoning.
Fuzzy Inference System: Mamdani fuzzy models, Sugeno Fuzzy Models, Tsukamoto fuzzy models, other considerations.
Least Square Method for system Identification: System Identification , Basic of matrix manipulations and calculus, Least-square estimator, Geometric interpretation of LSE, Recursive least-square estimator, Recursive LSE for time varying systems, Statistical Properties and maximum likelihood estimator, LSE for nonlinear models.
Derivative-based optimization: Descent methods, the method of steepest descent, Newton's methods, Step size determination, conjugate gradient methods, Analysis of quadratic case, nonlinear least-squares problems, Incorporation of stochastic mechanism.
Derivative-free optimization: Genetic algorithm simulated annealing, random search, Downhill simplex search, Swarm Intelligence, genetic programming.
Adaptive Networks: Architecture, Back propagation for feed forward networks, Extended back propagation for recurrent networks, Hybrid learning rule: combing steepest descent and LSE.
Supervised learning neural networks: Perceptions, Adaline, Back propagation multi layer perceptions, Radial Basic Function networks.
Learning from reinforcement: Failure is the surest path to success, temporal difference learning, the art of dynamic programming, Adaptive heuristic critic, Q-learning, A cost path problem, World modeling, other network configurations, Reinforcement learning by evolutionary computations.
Unsupervised learning and other neural networks: Competitive learning networks, Kohonen self-organizing networks, learning vector quantization, Hebbian learning, principal component networks, and the Hopfield network.
Adaptive Neuro-fuzzy inference systems: ANFIS architecture, Hybrid learning algorithms, Learning methods that cross-fertilize ANFIS and RBNF, ANFIS as universal approximator, Simulation examples, Extensions and advance topics.
Coactive Neuro-fuzzy modeling: towards generalized ANFIS: Framework, Neuro functions for adaptive networks, Neuro-Fuzzy spectrum, Analysis of adaptive learning capability.

Books:

1. J.S.R. Jng, C.T. Sun and E. Mizutani,"Neuro-fuzzy and Soft Computing", PHI.
2. S. Rajasekaran, G.A. Vijaylakshmi Pai,:Neural Networks, Fuzzy Logic, and Genetic Algorithms," PHI.

Service Oriented Architecture

Defining SOA, Business Value of SOA, Evolution of SOA, SOA characteristics, concept of a service in SOA, Stages of the SOA lifecycle, SOA Delivery Strategies, service-oriented analysis, Capture and assess business and IT issues and drivers, determining non-functional requirements, service-oriented design process, design activities, Distributing service management and monitoring concepts

Text Book :

Service-Oriented Architecture: Concepts, Technology and Design, by Thomas Erl, Prentice Hall Publication, 2005

Computer Graphics

Introduction: Display of entities, geometric computation and representation, graphics environments;
Working principles of display devices: Refreshing Raster scan devices, vector devices, cathode ray tube terminals, plotters;

Display of colors: Look-up tables, display of gray shades, half toning;
Display and drawing of graphics primitives: Point, line, polygon, circle, curves, and texts;
Coordinate conventions: World coordinates, device coordinates, normalized device coordinates, view-port and window, zooming and panning by changing coordinate reference frames;
Computations on polygons: Point inclusion problems, polygon filling, polygon intersections, clipping, polygonization of a point set, convex hull computation, triangularization of polygons;
Transformations in 2D and 3D: Translation, Rotation, Scaling, Reflection;
Projection: Perspective and parallel projections, isometric projection, Transformation matrices;
Volume and surface representation: Polygonal meshes, parametric curves and surfaces, Cubic and Bi-cubic Splines, Voxels, Octree and Medial axis representation, Sweep representation, surfaces and volumes by rotation of curves and surfaces, Fractal modeling;
Hidden surface and Line Elimination: Elimination of back surfaces, Painters' algorithms, Binary space partitioning tree;
Rendering and visualization: Shading model, constant, Goraud and Phong shading, Ray tracing algorithm, Radiosity computation;
Computer animation: Fundamental concepts.

Books:

1. Foley, "Computer Graphics: Principles and practice", 2nd Edition.
2. Mel Slater, "Computer Graphics and Virtual Environments 1/e", Pearson Education.
3. D.F.Rogers, "Procedural elements for Computer Graphics", Mc. Graw Hill, 1985.
4. K. A. Plastock and Borden Kelly: Schaum's Outline of Computer Graphics, 1986.
5. Newman and Sproull : Principles of interactive Computer Graphics, Mc. Graw Hill, International Students Edition, Kogakusha, 1981.
6. S. Harrington : Computer Graphics A Programming Approach, Mc. Graw Hill, 1986.

Wireless Sensor Networks

Unit I

Introduction: the vision, Networked wireless sensor devices, Applications, Key design challenges.

Network deployment: Structured versus randomized deployment, Network topology, Connectivity, Connectivity using power control, Coverage metrics, Mobile deployment.

Unit II

Localization: issues & approaches, Coarse-grained & Fine-grained node localization, Network-wide localization, Theoretical analysis of localization techniques.

Synchronization: Issues & Traditional approaches, Fine-grained clock synchronization, and Coarse-grained data synchronization.

Unit III

Wireless characteristics: Basics, Wireless link quality, Radio energy considerations, SINR capture model for interference.

Medium-access and sleep scheduling: Traditional MAC protocols, Energy efficiency in MAC protocols, Asynchronous sleep techniques, Sleep-scheduled techniques, and Contention-free protocols.

Sleep-based topology control: Constructing topologies for connectivity, constructing topologies for coverage, Set K-cover algorithms.

Unit IV

Routing: Metric-based approaches, Routing with diversity, Multi-path routing, Lifetime-maximizing energy-aware routing techniques, Geographic routing, Routing to mobile sinks.

Data-centric networking: Data-centric routing, Data-gathering with compression, Querying, Data-centric storage and retrieval, The database perspective on sensor networks.

Reliability and congestion control: Basic mechanisms and tunable parameters, Reliability guarantees, Congestion Control, Real-time scheduling.

Books:

1. Wireless Sensor Networks: Technology, Protocols, and Applications: Kazem Sohraby, Daniel Minoli, Taieb Znati , Wiley Inter Science.
2. Wireless Sensor Networks: Architectures and Protocols: Edgar H. Callaway, Jr. Auerbach Publications, CRC Press.
3. Wireless Sensor Networks: Edited by C.S Raghavendra, Krishna M, Sivalingam, Taieb Znati , Springer.
4. Networking Wireless Sensors: Bhaskar Krismachari, Cambridge University Press
5. Distributed Sensor Networks: A Multiagent Perspective, Victor Lesser, Charles L. Ortiz, and Milind Tambe , Kluwer Publications.
6. Wireless Sensor Networks: An Information Processing Approach- by Feng Zhao, Leonidas Guibas , Morgan Kaufmann Series in Networking 2004.

Stochastic Processes

Introduction to Probability; the axioms, the concept of random variables; functions of one, two and sequence of random variables.
General Concepts of stochastic processes; random walks and other applications; spectral representation; spectrum estimation; mean square estimation; entropy; markov chains and markov processes and queuing theory.

Reference Book

1. Probability, Random Variables and Stochastic Processes, 4th Edn., A. Papoulis and S. U. Pillai, TMH Publication
2. Probability, Random Variables and Random Signal Principles, 4th Edn, P. Z. Peebles Jr., TMH Publication
3. Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers- Roy D.Yates , David J.Goodman Wiley, John & Sons, Incorporated 2004.
4. Probability and stochastic processes for engineers- Carl W. Helstrom , Macmillan Publication 2007

Formal Language and Automata Theory

Formal languages and their related automata: Turing machines, Type-0 languages, Linear bounded automata and CSLs; Time and Tape bounded Turing machines, time and space bounds for recognizing CFLs;

Turing computability: Number theoretic computations by Turing machines and indexing; Axiomatic systems, their soundness and completeness,
Recursive function theory: Primitive recursive functions and primitive recursive predicates; Some bounded operations, Unbounded minimalization and μ-Recursive Functions, Godel Numbering, Ackermann's function, recursive and general recursive functions;
Computability and decidabilty: Computable functions, computable sets, decision problems, Fix-point theory of programs, functions and functionals, Verification methods, Lambda calculus and applications.

Reference Books :

1. Martin, " Introduction to language and the theory of computation" 3/e , TMH edition, 2009
2. Hopcroft & Ullman, " Introduction to Automata Theory, Languages and Computation", Narosa publications, 1999.

Lewis & Papdimitriou, " Elements of the Theory of Computation ", Prentice Hall

Software Technologies Lab.

Object-oriented programming concepts and implementation of abstract data types;
Implementation of graph algorithms; Linear programming with applications;
Basic of OS programming process creation and synchronization, shared memory and semaphore shell programming.

2nd Semester

Software Engineering

Software Life Cycle Models, Managing software projects, Project management concepts, Software process and Project metrics, Software Project Planning, Risk Analysis and Management, Project scheduling and tracking, Software Quality Assurance, Software Configuration Management. Conventional methods for software engineering, System Engineering, Requirements Analysis and Specifications, Analysis Modeling, Design Concepts and principles, Architectural design, User Interface Design, Component level Design, Software Testing Techniques, Software testing Strategies, Software Reliability, Technical metrics for software, CASE tools, Software Maintenance, Software Reusability.

Text Books:

1. R. S. Pressman, *Software Engineering A Practitioner's Approach*, TMH Publications.
2. R. Mall, *Fundamentals of Software Engineering*, Prentice Hall of India.

Reference Books:

1. I Sommerville, *Software Engineering*, Pearson Education.
2. P. Jalote, *An Integrated Approach to Software Engineering*, Narosa,
3. A. Behferooz & F. J. Hudson, *Software Engineering Fundamentals*, Oxford Univ. Press.
4. Baude, *Object Oriented Software Engineering*, Wiley.

Distributed Operating Systems

Introduction to parallel Computing, Solving problems in parallel, Structures of parallel computers, Instruction level parallel processing, Parallel Algorithms, Parallel programming, Operating Systems for parallel computers, Performance Evaluation of parallel computers.

Characterization of distributed systems, Design goals, Communication and computer networks, Distributed processing, Distributed operating systems, Client Server Communications, Remote Procedure calls, File Service, Name Service, Distributed transactions and concurrency control, fault tolerance and security. Synchronization & Coordination, Distributed Algorithms, research issues. Special topics in distributed operating systems.

Text Books:

1. G. Coulororis, J. Dollimore & T. Kindberg, *Distributed Systems: Concepts and Design*, Addison-Wesley.
2. M. Singhal & N. G. Shivaratri, *Advanced Concepts in Operating Systems*, McGraw Hill.

Reference Books:

1. P. K. Sinha, *Distributed Operating Systems*, IEEE Press.
2. H. F. Jordan, *Fundamentals of Parallel Processing*, Pearson.
3. C. Hughes & T, Hughes, *Parallel and Distributed Programming Using C++*, Pearson.
4. W. Buchanan, *Distributed Systems and Networks*, Tata McGraw Hill.
5. P. S. Pacheco, *Parallel Programming with MPI*, Morgan Kaufmann.

DISTRIBUTED DATABASE SYSTEM

1. Features of distributed databases, features of centralized databases, level of distributed transparency – Reference Architecture, types of Data Fragmentation, distribution Transparency, Access primitives, Integrity constraints.
2. Distributed Database design – A frame work, the design of database fragmentation, the allocation of fragments. Translation of global queries into fragment queries, query optimization.
3. Distributed Transaction Management – A framework, transaction atomicity, 2-phase commit, concurrency control: fundations, distributed deadlocks, timestamps.
4. Reliability: Basic concepts, commit protocols, consistent view of Network, Detection and Resolution of Inconsistencies, check points and cold restart.
5. Commercial Systems: Tranclem's ENCOMPASS

Distributed database systems, IBM's Inter system communication, feature of distributed ingres and Oracle.

6. Heterogeneous databases: General problems – brief study of multibase.

Text Book:

Ceri S. Pelagatti. G, Distributed Database systems Principles and Systems, Mc Graw Hill.

COMPILER CONSTRUCTION

Review of compiler fundamentals – Lexical analysis, parsing, semantic analysis, error recovery and intermediate code generation; Runtime storage management; Code Generation; Code improvement – Peephole optimization, dependence analysis and redundancy elimination, Loop optimization, procedural and inter-procedural optimization, instruction scheduling, optimization for memory hierarchy; compilation for high performance architecture; Probability and re-targatability;

Selected topics from Compilers for imperative: Object-oriented and mark-up languages, parallel and distributed programming and concurrency.

Text books and references:

1) A. V. Aho, R. Sethi, Lam, and J. D. Ullman, "Compilers", Pearson Education.
2) Alfred V. Aho, Jeffery D. Ullman, "Principle of Compiler Design",Narosa Pub House.
3) W. A. Barrett, R. M. Bates, D. A. Gustafson, and J. D. Couch, "Compiler Construction", Galgotia Book source Publishers, 1990.
4) D.M.Dhamdhere, "Compiler Construction", MacMillan India Ltd.,2nd Ed., 1997

Simulation and Modeling

Selected illustrative examples of simulation applications. Models: Structural, Process, Continuous, Discrete, Deterministic, Random, input/output, static, dynamic, multilevel. Simulation: Analog/Digital/Hybrid, verification, validation. Data Modelling and Analysis : Population parameters, hypotheses testing, confidence-intervals, goodness of fit, estimating transient/steady-state characteristics, variance reduction. Simulation Process : Problem formulating, model building, data acquisition, model translation, verification, validation, strategic and tactical planning, experimentation, analysis of results, implementation and documentation. Simulation Languages: Examples from SIMSCRIPT, GPSS, GASP, SIMULA, etc.

References:

1. G.Gordon, System Simulation, 2nd ed., Prentice Hall, 1978.
2. Narsing Deo, System Simulation with Digital Computers, Prentice Hall, 1976.
3. J.R. Leigh, Modelling and Simulation, Peter Peregrims Ltd., 1983.
4. A.M.Law, W.D.Kelton, Simulation Modelling and Analysis, Mcgraw Hill, 1982.

Mobile Computing

Overview of wireless technologies. Wireless multiple access protocols. Cellular systems: Channel allocation. Location management. Wireless LANs: Medium access, Mobile IP routing. TCP over wireless. Mobile ad hoc networking. Energy efficiency. Impact of mobility on algorithms and applications. Disconnected operation of mobile hosts. Data broadcasting. Mobile agents.

References:

1. J. H. Schiller. Mobile Communications. Addison Wesley, 2000.
2. A. Mehrotra. GSM System Engineering. Artech House, 1997.
3. Charles Perkins. Mobile IP. Addison Wesley, 1999.
4. Charles Perkins (ed.) Adhoc Networks. Addison Wesley, 2000 Relevant RFCs, internet drafts and research papers.

J2EE

Introduction: Java and Java applications; Java Development Kit (JDK); Java is interpreted, Byte Code, JVM; Object-oriented programming; Simple Java programs. Data types and other tokens: Boolean variables, int, long, char, operators, arrays, white spaces, literals, assigning values; Creating and destroying objects; Access specifiers. Operators and Expressions: Arithmetic Operators, Bitwise operators, Relational operators, The Assignment Operator, The? Operator; Operator Precedence; Logical expression; Type casting; Strings; .Control Statements: Selection statements, iteration statements, Jump Statements. Classes, Inheritance, Exceptions, Applets: Classes: Classes in Java; Declaring a class; Class name; Super classes; Constructors; Creating instances of class; Inner classes .Inheritance: Simple, multiple, and multilevel inheritance; Overriding, overloading. Exception handling: Exception handling in Java. The Applet Class: Two types of Applets; Applet basics; Applet Architecture; An Applet skeleton; Simple Applet display methods; Requesting repainting; Using the Status Window; The HTML APPLET tag; Passing parameters to Applets; getDocumentbase( ) and getCodebase( ); ApletContext and showDocument( ); The AudioClip Interface; The AppletStub Interface; Output to the Console.
Multi Threaded Programming, Event Handling: Multi Threaded Programming: What are threads? How to make the classes threadable; Extending threads; Implementing runnable; Synchronization; Changing state of the thread; Bounded buffer problems, read-write problem, producer-consumer problems. Event Handling: Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes.
Swings: Swings: The origins of Swing; Two key Swing features; Components and Containers; The Swing Packages; A simple Swing Application; Create a Swing Applet; Jlabel and ImageIcon; JTextField; The Swing Buttons; JTabbedpane; JScrollPane; JList; JComboBox; JTable.

TEXT BOOKS:

1. Herbert Schildt: Java The Complete Reference, 7th Edition, Tata McGraw Hill, 2007.
2. Robert W. Sebesta: Programming the World Wide Web, 4th Edition, Pearson Education, 2008.

Graph Theory

Basic Concepts: Graphs and digraphs, incidence and adjacency matrices, isomorphism, the automorphism group; Trees: Equivalent definitions of trees and forests, Cayley's formula, the Matrix-Tree theorem, minimum spanning trees; Connectivity: Cut vertices, cut edges, bonds, the cycle space and the bond space, blocks, Menger s theorem; Paths and Cycles: Euler tours, Hamilton paths and cycles, theorems of Dirac, Ore, Bondy and Chvatal, girth, circumference, the Chinese Postman Problem, the Travelling Salesman problem, diameter and maximum degree, shortest paths; Matchings: Berge's Theorem, perfect matchings, Hall's theorem, Tutte's theorem, Konig's theorem, Petersen's theorem, algorithms for matching and weighted matching (in both bipartitie and general graphs), factors of graphs (decompositions of the complete graph), Tutte's f-factor theorem; Extremal problems: Independent sets and covering numbers, Turan's theorem, Ramsey theorems; Colorings: Brooks theorem, the greedy algorithm, the Welsh-Powell bound, critical graphs, chromatic polynomials, girth and chromatic number, Vizing's theorem; Graphs on surfaces: Planar graphs, duality, Euler's formula, Kuratowski's theorem, toroidal graphs, 2-cell embeddings, graphs on other surfaces; Directed graphs: Tournaments, directed paths and cycles, connectivity and strongly connected digraphs, branchings; Networks and flows: Flow cuts, Max flow min cut theorems, perfect square; Selected topics: Dominating sets, the reconstruction problem, intersection graphs, perfect graphs, random graphs.

Text Books:

1. T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, Prentice Hall of India, 3rd ed, 2006.

2. N. Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall of India, 2004.

Reference Books:

1. D. B. West, Introduction to Graph Theory, 2nd Ed, Prentice Hall of India, 2007.
2. R. Diestel, Advanced Graph Theory, Springer Verlag Heidelberg, New York, 2005.
3. M. T. Goodrich and R. Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Wiley, 1st ed, 2001.

VLSI Design

Introduction to VLSI Design Methodologies, Full Custom Design, Semi Custom Design and Programmable design, VLSI Design Flow, Design Entry, Synthesis, Floorplanning, Place & Route, Timing analysis, Front – end design and Backend design.

Front End Design: Introduction to high level design, Hardware Description Language.

VHDL: Introduction, Behavioral Modeling, Sequential Processing, data types, Sub Program & packages, Attributes, Configurations. Synthesis: HDL (RTL description), Constraints, Technology Library, Synthesis: translation Boolean Optimization, Flattening, Factoring, Mapping gates. High level design flow. Synthesis tools : Synopsis.

Backend Design: Introduction to low level Design.

MOS Structure: Band Diagram, NMOS, PMOS, CMOS digital logic gates, Inverters

Digital Design: Static Logic & Dynamic logic design styles. Analog Design: Differential Amplifiers, Current Mirrors, design of operational amplifiers. Introduction to SPICE (T_Spice) for circuit simulation VLSI Technology.

Fabrication Process (NMOS & CMOS)

Wafer Preparation, Oxidation, Photo & Ion Lithography, Eatching, Diffusion, Ion implantation, Metalization.

Layout diagram and Layout of Digital Circuits, Introduction to Layout generation tools. (VLSI Software: Tanner L- Edit), CIF & GDS –II formats.

Design of Telecom Chips

Introduction to VLSI Design modulators, Demodulators, Transiver ICS, coder & Decoders. Companies Involved in Communication chip design.

Suggested text books and references

1) Application specific Integrated Circuits by Smith (For Unit –I)
2) VHDL by Douglas Perry, TMH Publication (for Unit-II)
3) VLSI Design & Techniques, Pucknell & Eshraghian, PHI (For Unit-III & Unit-V)
4) VLSI Technology, S. M. Size, Mc Graw Hill (For Unit-IV)
5) Resources from Internet : www.ti.com

CRYPTOGRAPHY

Introduction to Cryptography: Basics of Symmetric Key Cryptography, Basics of Assymetric Key Cryptography, Hardness of Functions
Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Goldwasser-Micali Encryption.
Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations
Formal Notions of Attacks: Attacks under Message Indistinguishability: Chosen Plaintext Attack(IND-CPA), Chosen Ciphertext Attacks (IND-CCA1 and INDCCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Interrelations among the attack model
Random Oracles: Provable Security and asymmetric cryptography, hash functions
One-way functions: Weak and Strong one way functions
Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF)
Building a Pseudorandom Permutation: The Luby Rackoff Construction: Formal
Definition, Application of the Luby Rackoff Construction to the construction of Block Ciphers, The DES in the light of Luby Rackoff Construction
Left or Right Security (LOR)
Message Authentication Codes (MACs): Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC
Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing
Assumptions for Public Key Signature Schemes: One way functions Imply Secure One-time Signatures
Shamir's Secret Sharing Scheme
Formally Analyzing Cryptographic Protocols
Zero Knowledge Proofs and Protocols

References:

1. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2. Wenbo Mao,Modern Cryptography,Theory & Practice, Pearson Edu. (Low Priced Ed.)
3. Shaffi Goldwasser and Mihir Bellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
4. Oded Goldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 2
M. Deitel, P.J. Deitel, A. B. Goldberg: Internet & World Wide Web How to Program, 3rd Ed, Pearson Education, 2004.

REFERENCE BOOKS:

1. Y. Daniel Liang: Introduction to JAVA Programming, 6th Edition, Pearson, 2007.
2. Chris Bates: Web Programming Building Internet Applications, 3rd Edition, Wiley India, 2006.
3. Xue Bai et al: The Web Warrior Guide to Web Programming, Thomson, 2003.

Speech Processing

Speech Processing: Introduction; Brief Review of Regular Expressions and Automata; Finite State Transducers; Word level Morphology and Computational Phonology; Basic Text to Speech; Introduction to HMMs and Speech Recognition. Indian language case studies; Part of Speech Tagging; Parsing with

CFGs; Probabilistic Parsing. Representation of Meaning; Semantic Analysis; Lexical Semantics; Word Sense; Disambiguation; Discourse understanding; Natural Language Generation; Techniques of Machine Translation; Indian Language case studies.

Pattern Recognition

Introduction to pattern recognition and applications to OCR, speech recognition, fingerprints, signatures etc. Commercial importance of applications. Introduction to Statistical, Neural and Structural Approaches. Statistical Pattern Recognition: Patterns and classification, discriminant functions, Bayes decision rule, nearest neighbour rule, probability of error. Linear discriminant functions: Perceptrons and training, LMSE approaches. Unsupervised learning and clustering. Feature extraction. Neural Approach: Introduction to artificial neural networks, feed forward networks, delta rule and back propagation, Hopfield networks and unsupervised learning, Adaptive resonance architectures, related techniques. Pattern associators and content addressable memories, hardware realizations. Syntactic pattern recognition: Formal languages and grammars Pattern grammars and higher dimensional grammars, Parsing, automata realizations, stochastic grammars, Grammatical Inference, computational learning theory, Valiant"s framework.

References:

1. R. J. Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, Wiley, 1992. 2.
2. R. O. Duda and P. E. Hart, Pattern Classification and Scene Analysis, Wiley, New York, 1973.
3. L. Miclet, Structural Methods in Pattern Recognition North Oxford Academic, London, 1986.

EMBEDDED SYSTEMS

Module – I (12 Hours)
Introduction: Features of Embedded systems, Design matrices, Embedded system design flow, SOC and VLSI circuit.
ARM: An advanced Micro Controller, Brief history, ARM pipeline, Instruction Set Architecture ISA: Registers, Data Processing Instructions, Data Transfer Instructions, Multiplications instructions, Software interrupt, Conditional execution, branch instruction, Swap instruction, THUMB instructions. FPGA

Module – II (12 Hours)
Devices and device drivers, I/O devices, Serial peripheral interfaces, IIC, RS232C, RS422, RS485, Universal serial bus, USB Interface, USB Connector IrDA, CAN, Bluetooth, ISA, PCI, PCI – X and advance busses, Device drivers.
Real time operating system: Hard real time, firm real time, soft real time, Task periodicity: periodic task, sporadic task, aperiodic task, task scheduling, scheduling algorithms: clock driven scheduling, event driven scheduling.

Module – III (08 Hours)
Software and programming concept: Processor selection for an embedded system, State chart, SDL, PetriNets, Unified Modeling Language (UML).
Low power embedded system design: Dynamic power dissipation, Static power dissipation, Power reduction techniques, system level power management.

Module – IV (08 Hours)
Hardware and software partitioning: K-L partitioning, Partitioning using genetic algorithm, particle swarm optimization, Functional partitioning and optimization: functional partitioning, high level optimizations. Hardware software co-simulations

Text Books:

1. "Embedded System Design " by Santanu Chattopadhay, PHI
2. "Embedded system architecture, programming and design" By Raj Kamal, TMH

Reference Books:

1. "Hardware software co-design of Embedded systems" By Ralf Niemann, Kulwer Academic.
2. "Embedded real time system programming" By Sriram V Iyer, Pankaj Gupta, TMH.

****