Biju Patnaik University of Technology, Orissa

Rourkela

Syllabus

of

M.Tech

in

Information Technology

From 2009 -2010 Academic Session

First Semester

Theory *Contact Hours*

	Professional Core	L-T-P	Credit
ITPC101	Software Engineering & Development Methodologies	3-1-0	4
ITPC102	Data Ware Housing & Data Mining	3-1-0	4
ITPC103	Information Theory and Coding Techniques	3-1-0	4
Professional Electives (Any Two) (3 Credits each)		3-0-0	3

CSPE102 Computational Intelligence
ITPE102 Advanced Computer Architecture
ITPE103 Advanced Operating System
ITPE104 Pattern Recognition
ITPE105 Multimedia Communication Systems
CSPE101 Real Time System
CSPE105 Wireless Sensor Network

Practicals / Sessionals *Contact Hours*

			L-T-P	Credit
CSPR101	Software Technologies Lab. - I	-	0-0-4	4 credits
ITPT101	Pre-thesis work & Seminar	-	0-0-3	2 credits

Total 24 Credits

Second Semester

Theory *Contact Hours*

	Professional Core	L-T-P	Credit
ITPC201	J2EE	3-1-0	4
ITPC202	Enterprise Resource Planning	3-1-0	4
Professional Electives(Any One)		3-0-0	3

CSPE201 Distributed Database System -
CSPE202 Compiler Construction
CSPE203 Simulation and Modeling

Professional Electives(Any One)	3-0-0	3

CSPE204 Mobile Computing
CSPE205 Graph Theory
CSPE206 VLSI Design

Professional Electives(Any One)	3-0-0	3

CSPE208 Speech Processing
EEPE206 Embedded System
CSPE207 Cryptography

Practicals / Sessionals *Contact Hours*

		L-T-P	Credit
ITPR201	Software Technologies Lab - II	0-0-6	4
ITPT201	Pre-thesis work & Seminar	0-0-3	2
ITCV201	Comprehensive Viva-voce – I		2

Total 25 Credits

Third Semester

Theory	*Contact Hours*	
Open Elective (Any One)	L-T-P	Credit
	3-0-0	*3*

1. Digital Image Processing
2. Software Project Management
3. Bio-Informatics
4. Formal Language and Automata

THESIS Part –I		14 Credits
	Total	17 Credits

Fourth Semester

ITPT401	Thesis Part - II	20 Credits
ITCV401	Seminar	2 Credits
ITCV402	Comprehensive Viva-Voce-II	2 Credits
	Total	24 Credits

Grand Total = 90 Credits

Software Engineering & Development Methodologies

Evaluation of Software Design Technique: Adhoc Base, Control Base, Data Structure, Data Flow, Objective Oriented. Process Model: SDLC, Component Base Software Developer Model, Unified Model, Fountain Model, 4P Approach: People, Process, Project, Product. Software Metrics: Process Metrics: LOC, COCOMO, PF, OO Process Metric, Use Case Process Metric.

Product Metrics: FP, Architectural Design Metrics, Metrics for OO Design, Class Oriented Metric, Coupling Metric, Cohesion Metric. Metrics for Testing. Project Metrics: Web Engg.

Object Technology: Object, Classes, Message, Class Hierarchy, Inheritance, Abstract, Encapsulation, Polymorphisms. Relationship: IsA, Has A, UsesA. Object Oriented Modeling:

Booch Notation, Rumbaugh Object Modeling Technique, Jacabson Model: Use Case, Abstract Use Case, Actor, Abstract actor. Use case Model: Domain Object Model, Analysis Object Model, Design Model, Testing Model, Implementation Model

UML Diagram: Class Diagram, Object Diagram, Sequence Diagram, Collaboration Diagram, Activity Diagram, State Chart Diagram, Component Diagram, Deployment Diagram

Object Oriented Analysis: Class: Interface Class, Control Class, Entity Class.Developing Use Case: Use case Element, Description, Case Study (i.e ATM), Class Classification Approach, Noun Phase Approach, Classical Approach, Function Point Approach, Structural Approach, CRC Card.
Object Oriented Design: Component Level Design, Cohesive, Coupling
Object Oriented Testing: System Testing: Requirement Specification, Integration Testing: Sequence Testing, Inheritance Testing, Polymorphism Testing, Encapsulation Testing
Unit Testing: Class Testing, Method Testing

Text Book
Software Engineering by Pressman McGraw Hill

Data Ware Housing & Data Mining

Introduction to Data Mining, Paradigm, Computing Paradigm, Business Paradigm, Business Problem Definition, Operational & informational Data stores, Data Warehouse Definition & characteristics, Data Warehouse Architecture, Client /Server Computing Model & Data Warehouse, Overviews of Client/server Architecture, Server specialization in client/server computing Environment, Server Function, Server H/W Architecture RISC verses CISC, Multiprocessor System, SMP implementation, Parallel Processors and Cluster Systems, Distributed Memory Architecture, Cluster System, Advances in Multiprocessing Architecture, Server Operating System, Operating System Implementation

Data Warehousing Component, Overall Architecture, Data Warehouse Database Sourcing, Acquisition, Cleanup &transformation Tools, Metadata, Access Tools, Data Marts, Data Warehouse Administration and Management, Information Delivery System, Business & Data Warehouse, Business Consideration :Return & Investment, Design Consideration, Implementation Consideration, Benefits of Data Warehousing, Mapping the Data Warehouse to Multi Processor Architecture, Database architecture for Parallel Processing, Shared Memory Architecture, Shared Disk Architecture, Shared Nothing Architecture, Combined Architecture

Introduction to Data Mining, Measuring Data Mining effectiveness: Accuracy , speed & Cost, Embedding Data Mining into your Business Process, Discovery verses Prediction, Comparing the Technology, Business Score Card, Application Score Card, Algorithm Score card, Decision Tree, CART, CHAID, Growing the Tree, When does the Tree stop growing, Strength & Weakness, Algorithm Score Card, Neural Network, Different types of neural N/W, Kohonen feature maps, Nearest Neighbor and Clustering, Business Score Card Where to use clustering & nearest neighbor prediction, Clustering for clarity, Clustering for out layer analysis, Nearest Neighbor for prediction, Application Score Card

Text Book :
Data Warehousing, Data Mining & OLAP by Alex & Stephen, McGraw Hill.

Information Theory and Coding Techniques

Introduction to information Theory, Information and entropy, properties of entropy of a binary memory less source, Measure of Information, Source Coding, Shannon-Fano coding, Huffman coding, Lempel ZIV coding, channel coding, Channel capacity, noisy channel coding theorem for DMC. Linear block codes, generator matrices, parity check matrices, encoder syndrome and error detection-minimum distance, error correction and error detection capabilities, cyclic codes, coding and decoding. Coding convolutional codes, encoder, generator matrix, transform domain representation state diagram, distance properties, maximum likelihood decoding, Viterbi decoding, sequential decoding, interleaved convolutional codes.

Text Book :

1. Elements of Information Theory , T.M.Cover, J.A.Thomas, Wiley
2. R.McEliece, The Theory of Information and Coding, Addison-Wesley.

Professional Electives (Any Two)

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.

Advanced Computer Architecture

Introduction to parallel processing: Evaluation of Computer System, parallelism in Uniprocessor system, Parallel computer system, Architectural classification Schemes, Parallel Processing Applications. Memory and Input-Output Subsystems : Hierarchical Memory Structure, Virtual memory System, Memory allocation and Management, Cache Memories and Management, Input-Output Subsystems. Principles of pipelining and vector processing: Pipelining, Instruction and Arithmetic Pipelines, Principles of Designing Pipelined Processor, Vector Processing Requirements. Structure and Algorithms for array processors: SIMD Array Processors, SIMD Interconnection Networks, Parallel Algorithms for array Processors, Associative Array Processing. Multiprocessor architecture and programming: Inter-processor Communication Mechanisms, System Deadlocks and Protection, Multiprocessor Scheduling Strategies, Parallel Algorithm for Multiprocessor. Data flow computer and VLSI Computations: Data Driven Computing and Languages, Data flow Computer Architectures, VLSI Computing Structures.

Text Book :

1. J. L. Heressy and D. A. Pattersan “Computer Architecture A Quantitative approach”, Morgan Kaufmann, 1990.
2.Kai Hwang, “Advanced Computer Architecture: Parallelism, Scalability, programmability”, Mc-Graw Hill.

Advanced Operating System

System Architecture Types, Distributed Operating Systems, Lamport’s Logical Clocks, Vector Clocks, Causal Ordering of Messages, Global State, Chandy-Lamport's Global State Recording Algorithm, Cuts of a Distributed Computation, Termination Detection, Mutual Exclusion Algorithms, Performance Measures, Non-Token-Based Algorithms, Token-Based Algorithms, Comparative Performance Analysis, Deadlock Handling Strategies, Centralized Deadlock-Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms, Agreement Protocols, Distributed File Systems, Distributed Shared Memory, Distributed Scheduling, Multiprocessor Operating Systems.

Text Book :

1. M. Singhal and N. G. Sivaratri, “Advanced concepts in Operating Systems”, Tata McGraw Hill Publications, 2001.
2. Coulouris, "Distributed Systems: Concepts and Design", Pearson Education.

Pattern Recognition

Introduction, Machine perception, Pattern Recognition Systems, Design cycle, Learning & adaptation,(Ch.1) Bayesian Decision Theory in discrete & continuous features(Ch. 2.1 to 2.6, and 2.9) Maximum likelihood and Bayesian parameter estimation (Ch.3.1 to 3.5, 3.10) Nonparametric techniques (Ch. 4.1 to 4.6) Linear discriminant functions (Ch. 5.1 to 5.9), Non-metric method (Ch. 8.1 to 8.3, 8.6 , 8.7)

Text Book:

R. O. Duda, P. E. Hart and D. G. Stork, “Pattern Classification” Wiley Publ. 2nd Edition

Multimedia Communication Systems

Multimedia Information Systems , A framework for Multimedia systems ,Multimedia conferencing model, Multimedia distributed processing model, Media and data streams, Audio, Video and animation, data compression, Multimedia Operating System , Multimedia networks, Multimedia information representation, Compression techniques, Standards for Multimedia Communication, Digital Communication basics, Multimedia Communication Systems, Synchronization, Multimedia applications.

Book:

1. Multimedia Communications by Buford, Pearson
2. Multimedia: Computing, Communications & Applications by Ralf & Klara, Pearson Ch: 11, 15, 17
3. Multimedia Systems by Fred Halsal, Pearson Ch: 1 to 6
4. Multimedia:Computing, Communications & Applications by Ralf & Klara,Pearson Ch:1 to 9

Real Time Systems

UNIT-1 *[10Hrs]*

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

Book:

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

Wireless Sensor Network

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.

Software Technologies Lab. - I

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

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.

ENTERPRISE RESOURCE PLANNING

INTRODUCTION

ERP Concepts – Enterprise System – Evolution of ERP – Tangible and Intangible Benefits – Emerging Trends in ERP adoption – ERP Implementation Stages – case Study.

PRE – IMPLEMENTATION STAGE

Need Analysis – Competitive Environment Analysis – Gap Analysis – Cost Elements – Feasibility Analysis – ERP Modules – ERP Industries verticals – ERP Architecture –ERP Software – SAP - Baan – IFS – Oracle – people Soft Comparison of ERP Software – ERP Package Evaluation Criteria – Package Life Cycle – Request for Information – Functional Requirement Specification – Request for Proposal – Vendor Selection – ERP Consultants – Case Studies.

IMPLEMENTATION

Business Process Reengineering Concepts – Reengineering and Process Improvement – BPR Steps – AS-IS and TO – BE Analysis – Modeling Business Process – Successful BPR – Reengineering – Organizational Readiness – Implementation Approaches.

PROJECT MANAGEMENT

Project Management – Project Team – Steering Committee – Project Manager – Functional Team – IS Team – Security Specialists. Project Deliverables – Change Management – System integration – Systems Integration standards – Middleware Development – Forward and Reverse Engineering – ERP Infrastructure Planning – System Architecture

POST IMPLEMENTATION

Organizational Transformational Model of ES Success – Cross Functional, Organizational and Industrial Impacts. Measuring Business Benefits – Balanced Score card Method – ABCD Checklist Framework – Capability Maturity Framework – case study.

References:

1. *Mahadeo Jaiswal and Ganesh Vanapalli, Text Book of Enterprise Resource Planning,*
   Macmillan India Ltd., Chennai 2005.
2. Alexis Leon, Enterprise Resource Planning Demystified, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
3. Vinod Kumar Grag and N.K. Venkitakrishnan, Enterprise Resource Planning – Concepts and Practice, Prentice Hall of India, New Delhi, 1998.

Professional Elective – III (Any One)

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.

Suggested 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 Publishing 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.

Professional Elective – IV(Any One)

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.

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

Professional Elective – V(Any One)

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.

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.

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

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