M.TECH. COURSES WITH CONTENTS
Revised Course Structure for M.Tech.

Semester I

Data Structures and Algorithms

CS-701


Books
2. Weiss, "Data Structures and Algorithm Analysis in C", Addison Wesley.

Theoretical Computer Science

CS-702

Introduction: Mathematical background and basics
Mathematical Logic: Predicate calculus, wff, normal forms, deduction systems, resolution methods, unification algorithm

Formal languages and Chomsky hierarchy:
- Regular Expression, Regular Grammars, Regular Languages, Closure properties, Kleene’s theorem, Finite Automata, deterministic and nondeterministic, pumping theorem, algorithmic aspects of FAs: state minimization, equivalence, membership
- Context-Free Languages, Context-Free Grammars, Parsing, Pushdown Automata, equivalence of PDAs and CFG’s, closure properties, Pumping theorem, CF and non-CF languages, CNF, Chomsky’s hierarchy

Formal computation:
- Computability theory, Turing machines and variants, recursive languages, recursively enumerable languages
- Undecidability - Church-Turing thesis, reduction, decidable (recursive) and Turing-recognizable (r.e.) problems, Universal Turing machine, Halting problems

Computational Complexity: Measuring complexity, Class P and NP, P vs. NP questions, NP-completeness, examples

Text Books:
Mathematical Theory of Computation, Zohar Manna

1. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Pearson Education Asia, 2e, (third Indian reprint) 2002
2. Introduction to Computer Theory, 2e, Daniel I.A. Cohen, John Wiley.
3. Theory of Computer Science (Automata, Languages and Computation), 2e, Mishra and Chandrasekaran, PHI.

Data Communication and Computer Network

Overview of Computer Network; Data Communication – Analog and digital communications, signal and data, Channel characteristics, Nyquist theorem, Shannon’s formula, modulation techniques, encoding schemes, Error Detection – VRC, LRC, CRC, Checksum; Transmission media; Multi-channel communication – multiplexing techniques, Multiple access techniques; Switching techniques – Telephone systems, ATM, Queuing Models – little’s theorem, Poisson Process, Markov Chain model, M/M/1, M/M/S/K, M/G/1 queues; ALOHA systems; Local Area Networks – CSMA/CD, Token Ring, Token Bus, FDDI, CSMA/CA; Routing – spanning tree, Bellman-Ford, Dijkstra algorithms, Distance vector and link state routing; IP protocol- fragmentation, reassembly; Transport Protocol – stop-and-wait, Sliding window protocols, congestion control, TCP, UDP; Application Protocols – FTP, Email, SMTP and Telnet;

Books

Semester II

Operating Systems


**Computer Architecture**


**Looks**


**Activies**

**Group - I**

**Database Management System**


**CS-705**


Object oriented Software Engineering


Books:
2. Booch Grady, Rumbaugh James, Jacobson Ivar, "The Unified Software Development Process", Addison Wesley Longmen
4. Quatrani Terry, "Visual Modelling with Rational rose and UML", Addison Wesley
5. Gamma, et al., "Design Patterns, Elements of Reusable Object Oriented Software", Addison Wesley.

Artificial Intelligence

Overview of AI: Foundations, History and State of the Art; Intelligent Agents, Problem Solving; Search, Game Playing; Knowledge and Reasoning: Agents that Reason Logically, First Order Logic, Building Knowledge Bases, Logical reasoning Systems; Planning; Uncertain Knowledge an Reasoning; Learning; Learning from observations; Learning in Neural and Belief Networks, Reinforcement Learning; Communicating, Perceiving and Acting: Agents that Communicate, NLP, Perception, Robotics.

Books

Computational Biology

1. Basic Concepts of Molecular Biology
2. Sequence Comparison- Comparing two Sequences, Global pair wise sequence alignment, Multiple sequence alignment
3. Database search- PAM matrices, BLAST, FAST.
5. Phylogenetic trees, probabilistic approaches, Algorithms for distance matrices
6. Transformational grammars, RNA structure analysis, RNA secondary structure predictions

Books:
Setubal, J. and Meidaris, J., Introduction to Computational Molecular Biology, Thomson 2003
2. Clote, P., and Backofen, R., Computational Molecular Biology, Wiley, 2002
4. Baldi P., Hatfield G.W., "DNA Micro arrays and Gene Expression (From Experiments to Data analysis and Modeling)", Cambridge University, 2002.

Real Time Systems


Books:

Compiler Construction


Books:

Books

System Modeling and Simulation
1. Characterizing Systems, Models of a System, Concept of Simulation
2. Modeling Dynamic Systems - Discrete Delay, Distributed Delays
5. Monte Carlo Simulation - Hit or Miss method, sample Mean convergence, Error Analysis, Simulation of Probability Experiments, Importance Sampling
6. Analysis of Simulation Data, Verification and Validation of Simulation Models, System Design

Books:

Group - II

Overview of Machine Learning: Concept Learning and the General - to - Specific Ordering; Decision tree Learning; Neural Networks; Evaluating Hypothesis; Bayesian Learning; Computational Learning Theory; Instance Based Learning; generic Algorithms; Learning Sets of Rules; Analytical Learning; Combining Inductive and Analytical Learning, Reinforcement Learning.

Machine Learning

Data Mining and Knowledge Discovery

Applications of data mining – Complex data mining, Text data mining, Web mining, Stream mining, Scientific data mining, Current research topics in the area.

Text Books:

Reference Books:

Data Warehousing

Overview of Databases and Conceptual Modelling, DW Characteristics, Architecture, Dimensional Modeling, Designing Warehouse, ELT (Extraction, Transformation and Loading), Meta Data, Information Delivery, OLAP functions, and Tools, ROLAP and MOLAP Representation, Data Mining, Modern Topics.
Image Processing and Computer Vision

1. Image representation and Formation: Spatial Representation, Fourier Transform, Multi scale representation, Quantitative Visualization, Linear System Theory of Imaging, 3D Imaging, Tomography, Depth from Triangulation.
2. Sampling and Quantization: Sampling, Windowing, Reconstruction from Samples, Pixel Processing, and Geometric Transforms.
5. Recognition: Shape Distance Measures, Template Matching, Clustering, Statistical Classification, Syntactic Recognition, Graph Matching.

Books:

Wireless Communication and Mobile Computing

Introduction – Evolution of mobile radio communication, Various generations of Wireless Networks, Examples of wireless communication; Cellular Networks – introduction, frequency reuse, hand-off strategies, interference and channel capacity, coverage and capacity improvement; Mobile radio propagation – large-scale path loss, small-scale fading and multipath; Modulation techniques – linear, constant envelope, combined (linear and CE), spread spectrum; Multiple access techniques; Wireless standards, wireless LANs, Voice quality analysis.

Books:
Performance Modeling of Communication Networks

Importance of Quantitative Modeling, Some Illustrative Examples
M/M/1 Queuing System, Little’s Law, State Dependent Queuing System, Erlang’s B and C Formula, M/G/1 Queuing System.

Books:

Mobile Ad Hoc Networks

Packet Radio networks - Technical challenges, Architecture, components, routing in RNETs, route calculations; Ad Hoc Networks - application, heterogeneity of mobile devices, traffic profile, sensor networks, challenges facing Ad Hoc networks; Media access protocols - Hidden terminal problem, exposed terminal problem, MACA, MACA-L, PAMAS, DBTMA; Routing protocols - topology-based, and position-based, multicast routing; Mobility and location Management - mobility models, location update strategies; energy Conservation Issues - device power management, protocol power management; performance of Ad Hoc networks

Books:

Optical networks

Introduction to optical networks and the optical layer; transmission, multiplexing, amplification in optical media; loss, bandwidth, dispersion and non-linear optical effects in optical fiber, components in an optical network – couplers, isolators, circulators, multiplexers, filters, amplifiers, sources, detectors, switches and wavelength converters; design of optical transmission systems with optical amplification, crosstalk, dispersion, management and wavelength planning, control and management of optical layers, optical fiber survivability and reliability.


**Embedded Systems**

Categories and requirements of embedded systems, Challenges and issues related to embedded software development, Hardware/Software co-design, Concepts of concurrency, processes, threads, mutual exclusion and inter-process communication, Models and languages for embedded software, Synchronous approach to embedded system design, Scheduling paradigms, Scheduling algorithms, Introduction to RTOS, Basic design using RTOS, Interfacing, RISC Processor: Architecture, Memory, Reset and interrupt, functions, Parallel I/O ports, Timers/Counters, Serial communication, Analog interfaces. Case studies and Applications of embedded systems

**Books:**

1. Raj Kamal, "Embedded Systems", TMH


**Cryptography**

Introduction: Encryption and Secrecy, Attacks, Cryptographic Protocols, Provable Security
Symmetric key and Public key Cryptography: Stream Ciphers, Block Ciphers, Modular Arithmetic, RSA, Hash Functions, The Discrete Logarithm, Modular Squaring
Cryptographic Protocols: Key Exchange and Entity Authentication, Identification Schemes, Commitment Schemes, Electronic Elections, Digital Cash
One-Way Functions and the Basic Assumptions: Discrete Exponential Function, Uniform Sampling Algorithms, Modular Powers, Quadratic Residuoity Property, Formal Definition of One-Way Functions, Hard-Core Predicates

**Books:**


Pattern Recognition

- Pattern Recognition Systems, Supervised/Unsupervised Learning, Reinforcement Learning
- Statistical Pattern Recognition: Introduction to Statistical Pattern Recognition, The Bayesian Case and Class Dependence, Discriminant Functions, Classifier Performance, Risk, and Errors
- Linear Discriminant Functions: Linear Discriminant Functions and Decision Surfaces, Generalized Linear Discriminant Functions, The two category Linearly Separable Case, Minimizing the Perceptron Criterion Function, Relaxation Procedures, No separable Behavior, Minimum Square Error Procedures, Linear Programming Algorithms, Support Vector Machines
- Unsupervised Learning and Clustering: Formulation of Unsupervised Learning Problems, Hierarchical Clustering, Partitional Clustering, Density Based Clustering, Learning Vector Quantization
- Syntactic Pattern Recognition: Quantifying Structure in Pattern Description and Recognition, Grammar Based Approach and Applications, Elements of Formal Grammar, Recognition of Syntactic Descriptions, Parsing, Graph Based Structural Representations
- Neural Pattern Recognition: Neural Network Structures for Pattern Recognition Applications, Single Layer Perceptron, Multilayer Backpropagation Algorithm, Radial Basis Function Network, Hopfield Nets, Kohonen Network

Books:
1. Pattern Recognition Statistical, Structural and Neural Approaches, R. Schalkoff (Wiley)
3. Pattern Recognition and Image Analysis, E. Gose, R. Johnsonbaugh and S. Jost (PHI)

Computational Finance

3. Option Pricing Models- Binomial Option pricing model, Black- Scholes formula.
4. Forwards, Futures, Future Options, Forward Contracts.
5. Continuous time functional mathematics- Stochastic integrals, Black- Scholes differential equation, Hedging and Futures, Hedging and Options.

Books:
VLSI Technology

Introduction to MOS Circuits, Circuit Characterization and Performance Estimation, CMOS Circuit & CMOS Sub System Design.
3. Environment for VLSI technology, Impurity incorporation, Oxidation, Lithographic techniques, Diffusion, Ion Implantation, Chemical Vapor Deposition techniques, Metallisation techniques
4. Circuit implementation of simple combinational and sequential circuits.
5. Layout Compactation, Floorplanning, Routing.
6. Basic concepts of hardware description language VHDL

Books:
3. Bhasker," VHDL primer", PH India

Multimedia Systems

Introduction – components of multimedia, multimedia and hypermedia, multimedia and S/W tools; Multimedia Authoring – metaphor, production, presentation automatic authoring, VRML; Graphics and Image data representation; Color in Image and Video – color science, color models in image and video; Fundamentals of video – type of video signals, analog and digital video; Basics of Digital Audio – digitization, quantization, MIDI, Multimedia Data Compression – lossy compression, Image compression standards, basic video compression techniques, MPEG video coding, MPEG audio compression; Multimedia communication – quality of multimedia transmission, multimedia over IP, video delay in ATM, multimedia across DSL.

Books:

Distributed Databases

Overview; Principles; Dimensions-Distribution, Heterogeneity, Autonomy; Distributed Database Architecture – Client-Server, Peer-to-Peer, Federated, Multidatabase; Distributed Database Design and Implementation – Data Fragmentation, Data Replication and Data Allocation Techniques; Distributed Query Processing and Optimization; Distributed Transaction Management, Concurrency Control and Reliability; Distributed Database Interoperability

**Advanced Software Engineering CS-729**

Overview of Software Engineering, Methods of Analysis and Design of Software Systems, Coding Standards and Guidelines, Theoretical Foundation of Testing - Coverage Criteria, Software Debugging, Software Reviews, Software Project Metrics and Estimation Techniques - Empirical, Heuristic and Analytical Techniques, Software Project Planning and Scheduling - PERT and CPM; Software Project Crashing; Software Reliability Metrics and Models, Software Availability, Software Risk and Configuration Management; Software Reuse; Software Re-engineering, CASE Tools and Support; Software Quality Assurance

**Books:**
COMPUTER GRAPHICS

M.TECH

• Display devices, Refreshing display devices, Raster scan display devices, Random scan display devices
• Transformations in 2D, Translation, Rotation and Scaling, Homogeneous Coordinate System
• Line Clipping, Cohen Sutherland line clipping algorithm
• Transformation in 3D, Translation, Rotation and Scaling
• Representation of 3D objects, Projections, Parallel projection, Orthographic and Isometric projections, Perspective projections, Vanishing point
• Hidden Surface Removal, Depth buffer algorithm, Scan line Z-buffer algorithm, Area subdivision algorithm, BSP algorithm
• Rendering, Diffuse and Specular reflections, Gouraud and Phong Shading models
• Curves and Surfaces, Bezier and B-Spline Curves and Surfaces
• Animation, Simulation of Acceleration

REFERENCES

Software Engineering

Syllabus (M.Tech.)

Introduction: overview, software crisis, principles, software product, process and their characteristics, software development process and process models; software verification and validation; requirement analysis: issues, principles, structured analysis methodology; requirement specification: SRS characteristics, components and structure, specification tools; design: issues and principles, system and detailed design, structured design methodology; coding: standards and guidelines, structured programming; testing: theoretical foundation of testing, testing techniques and strategies, debugging; maintenance: types and characteristics. Software metrics: size, cost and effort estimation techniques; software project planning and scheduling- PERT and CPM; software project crashing, software reliability metrics and models – time dependent models: time between failure and fault counting models, time independent models: Input domain and fault seeding models, software availability.

Books:

Graph Theory & Applications

Brief history of the Graph Theory, Definition, Finite & Infinite Graph, Incidence and Degree, Isolated vertex, Pendant vertex & null graph, Isomorphism, Walk, Path and Circuits, Connected & Disconnected Graphs and its components

Euler Graphs, Operation on Graphs, Hamiltonian Paths and Circuits, Trees, Some properties of the tree, Distance & Center, Rooted & Binary Tree, Spanning Tree, Spanning trees in a weighted graph

Fundamental Circuits & Cut sets, Properties of cut set, connectivity & separability, Planner graphs, Kurthawski's Graphs, detection of planarity, geometric dual, Directed graphs, Directed paths and its connectedness, Euler diagraphs, trees with directed edges, fundamental circuits in digraphs

Adjacency matrix of a digraph, acyclic digraph and decyclization, Matrix representation of graphs

Chromatic number, Chromatic partitioning, matchings, coverings, Four colour problem

Vector spaces of graphs, Sets with two operations, Mod arithmetic and Galois field, Vectors and vector spaces, Basis vectors of a graph, Circuit and cutset subspaces, orthogonal vectors & spaces

Graphs in switching and coding theory, graph theory in operations research

Text Books
1. Narsingh Deo, Graph Theory and its application to Science and Engineering, PHI
2. Douglas B. West, Introduction to Graph Theory 2nd Ed., Pearson Education
M.Tech.

Parallel & Distributed Processing

Parallel processing concept, Parallelism in conventional machine, Pipelining, Flynn's classification, Feng's classification, Array processor, Amdahl's law, Minsky's conjecture.

Static and dynamic networks, Single stage and multistage interconnection network, Blocking and nonblocking network, Star, Ring, Mesh, Torus, Pyramid etc. topology, Elementary permutations used in Interconnection network, Clos, Benes network, Shuffle exchange, Hypercube, PM2I network.

Simple addition on various network topologies, Recurrence computation, Matrix multiplication, Sorting networks 0-1 Principle, Bitonic sort, Merger, Sorter.

PRAM Model, EREW, ERCW, CREW, CRCW algorithms.

Distributed computation, characteristics of distributed systems, overview of related networking, operating systems and programming language concepts.

Interprocess communication, message passing communication, remote procedure call (RPC), atomic transactions.

Distributed coordination, physical and logical clocks, synchronization, mutual exclusion, leader election.

Textbooks:

1. Advanced Computer Architecture: Kai Hwang
2. Parallel Computing: M.R. Bhujade
3. Algorithms: Cormen
4. Distributed System: Tanenbaum
5. Distributed Algorithms: Nancy A. Lynch
M.Tech.

Distributed Systems

Distributed computation, characteristics of distributed systems, overview of related networking, operating systems and programming language concepts

Interprocess communication, message passing communication, remote procedure call (RPC), atomic transactions

Distributed coordination, physical and logical clocks, synchronization, mutual exclusion, leader election in a general network, Breadth-First Search, Shortest Paths, Minimum spanning tree

Failure and fault tolerance, failure models, safety and liveness properties, distributed agreement in the presence of failures, distributed consensus with Link failures, distributed consensus with process failures

Scheduling in Distributed computing system

Textbooks:

1. Distributed System: A.S. Tanenbaum, Pearson Education
2. Distributed Algorithms: Nancy A. Lynch, Elsevier
Object Oriented Programming

Object oriented programming focuses on analysis, designing and programming skills such as program design and testing as well as the implementation of programs in C++. This is a course for M. Tech., majors with a focus on object-oriented programming.

Contents:

Concept of Object-Oriented Programming paradigm: Abstraction, Encapsulation, Persistence, Inheritance, Polymorphism, object-oriented analysis, object-oriented design, Classes, Objects, meta class, member function, static member function, const member function, struct, union, Type conversions and Casting, Arrays, pointers to class’s members and object’s members, Memory Allocation for Objects, Storage Management, constructors: default, parameterized and copy constructors, private constructor, destructor, virtual destructor, private destructor, Inheritance: single and multiple inheritances, Friend function and friend class, operator overloading, function overloading, Polymorphism: static and dynamic binding, virtual function, pure virtual function, abstract class, overriding, memory layout of objects: virtual pointer and virtual table; virtual class; Exception Handling, Template: class and function, I/O stream classes, file handling, Conditional Compilation.

Books:

Topics in Mathematical Sciences  3 Credits
[to be introduced from Winter Semester 2007]

- Compulsory for Direct Ph.D. students
- Optional Course for M.Tech II Semester


Books:


