M.TECH. COURSES WITH CONTENTS

Annexure VII

13 Pages

Revised Course Structure for M.Tech.

Semester I

Data Structures and Algorithms CS-701

Complexity of algorithms : Worst case, Average case and Amortized Complexity; Algorithm analysis; Lists, Stacks and Queues; Trees: Binary search trees, AVL trees, Red-Black trees, M-way and B trees, Splay trees, Hash tables; Priority Queues: Binary heap, D-heaps, Skew heaps, Binomial Queues; Sorting: Quick sort, Heap sort, Merge sort and external sorting, Bin and Radix sort; Graphs: Topological sort, Shortest path, Network Flow problem, Minimum Spanning Tree, Algorithm Design Techniques: Greedy Algorithms, Divide and Conquer, Dynamic Programming, Randomized Algorithms, Back tracking; NP completeness.

Books

1. Aho, Hopcraft and Ullman. " Data Structures and Algorithms", Addison Wesley.
2. Weiss, " Data Structures and Algorithm Analysis in C", Addison Wesley.
3. Cormen, Leiserson, Rivest and Stein," Introduction to Algorithms", Prentice Hall.
4. Knuth, " The Art of Computer Programming", Vol I and Vol III, 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:

1. Elements of the Theory of Computation, Lewis and Papadimitriou, Pearson Education Asia, First Indian reprint, 2001.
2. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft and Jeffery D. Ullman, Narosa Publishing House, (8th Reprint) 1992.

Approved in the special committee meeting held on 19-4-2005 and 6-5-2005

Mathematical Theory of Computation, Zohar Manna.

Reference Books:

1. Introduction to Automata Theory, Languages and Computation, John E. Hopcroft, Rajeev Motwani and Jeffery D. Ullman, Pearson Education Asia, 2e, (Third Indian reprint) 2002Introduction to Computer Theory, 2e, Daniel I.A. Cohen, John Wiley.
2. An Introduction to Formal Languages and Automata, 2e, Peter Linz, Narosa Publication.
3. Theory of Computer Science (Automata, Languages and Computation), 2e, Mishra and Chandrasekaren. PHI.
4. Introduction to Languages and the Theory of Computation 2e, John C. Martin; Tata McGraw-Hill.
5. Fundamentals of the Theory of Computation principles and practice, Raymond Greenlaw and H. James Hoover; Morgan Kaufman Harcourt

Data Communication and Computer Network CS-703

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

1. Behrouz A. Forouzan, *Data Communication and Networking*, 2nd ed., Tata McGraw-Hill, 2000.
2. Dimitri Bertsekas and Robert Gallager, *Data Networks*, 2nd ed., PHI, 2001.
3. William Stallings, Data and Computer Communications, 6th ed., Pearson Education, 2002.

Semester II

Operating Systems CS-704

Overview, Computer System Structures, Operating System Structures, Process and Process Scheduling, CPU scheduling, Process Synchronization, Semaphores, Monitors, Deadlock and methods of deadlock handling, Memory Management, Swapping, Address Space, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms, File and Directory Concepts, Access Methods, File System Allocation methods, Secondary Storage Scheduling and Management, Protection, Security. Distributed Operating system, issues, structures, file systems, distributes co-ordination, mutual exclusion in distributed system, deadlock. Case Studies: The Linux system

1. Silberschatz and Galvin, *Operating System Concepts*, 6th ed., Wiley, 2004
2. Stallings William, *Operating Systems*, 3rd ed., PHI.
3. Tanenbaum, Modern Operating systems, PHI
4. Milan Milenkovic, Operating Systems, Tata Mc Graw Hill.

Computer Architecture CS-705

Overview of Computer Architecture, Digital Computer Design, Addressing Modes, Instruction Set Architecture, Memory Organization, CPU Organization, I/O Organization, Control Unit Design.

Pipelining, Super scalar and Vector Processing. Parallel Processing: Types and Levels of Parallelism, Classification of Parallel Architecture. Multiprocessors and Multicomputers. Interconnect Networks. Cache Coherence Issues.

oks:

1. Mano Morris," Computer System Architecture", 3rd Edition, Pearson Education.
2. Hwang Kai," Advanced Computer architecture", Tata MacGraw Hill.
3. Sima, Fountain, Kacsuk," Advanced Computer Architecture - A Design Space Approach", Pearson Education.

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Group - I

Database Management System CS-706

Introduction: Early database Systems, Client Server and Multitier Architecture, Multimedia.Data and Information Integration, Entity Relationship Model. Entity set, Attributes relationship, Entity relationship diagram, Instances of an ER Diagram with Multiplicity of Binary ER Relationship, Relational Integrity. Logical Query Languages, SQL: data Manipulation Language and SQL. Data definition, Query Processing: Overview of Query Processing, Query Decomposition, Cost Estimation for he Relational Algebra Operation. Tuple Calculus Query and Domain Calculus Query, Database Analysis and design techniques, Database Design, Planning, Design and Architecture(Information system Life Cycle, Database Application Life Cycle, Database Planning), Normalization: The Purpose of Normalization, Data Redundancy nd other Anamolies, Functional Dependencies.The Process of Normalization (1st NF, nd NF, 3rd NF, Boyce -Code Normal Form(BCNF), 4th NF, 5th NF, Transactions, Concurrency Control and Recovery.

ts:

Silberschatz, A., Korth, H.F., Sudarshan, S., Database System Concepts, Fourth Edition, McGraw-Hill International Edition
. Elmasri, R., Navathe, S.B., Fundamental of Database Systems, Fourth Edition, Pearson Education
. Desai, B.C., An Introduction to Database Systems, Galgotia Publications

ate, C.J., An Introduction to Database Systems, Seventh Edition, Pearson Education

Object oriented Software Engineering CS-707

Introduction to Object oriented Concepts, Modelling Classes with UML, Modeling Interactions and Behavior, Architectural Modeling, Analysis v/s Design, Object Oriented Testing Techniques, Reusability Concepts, Software Development Process Model (For Ex. Rational unified Process), Modern Topics.

Books:

1. Booch Grady, Rumbaugh James, Jacobson Ivar, " The Unified Modeling user Guide", Addison Wesley Longmen.
2. Booch Grady, Rumbaugh James, Jacobson Ivar, " The Unified Software Development Process", Addison Wesley Longmen
3. Pressman, Roger S.," Software Engineering- A Practitioners Approach", MacGraw Hill.
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 CS-708

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

1. Russel and Norvig," Artificial Intelligence- A Modern Approach", Pearson Education, 2002
2. Rich and Knight," Artificial Intelligence", Tata Macgraw Hill, 1999
3. Winston," Artificial Intelligence", 3rd Edition, Addison Wesley, 1999

Computational Biology CS-709

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.
4. Hidden Markov Models, Pair wise alignment, Likelihood and Scoring a Model.
5. Phylogenetic trees, probabilistic approaches, Algorithms for distance matrices
6. Transformational grammars, RNA structure analysis, RNA secondary structure predictions
7. System Biology Concepts, computational Models of Regularity Networks, The Search for General Principles.

Books :

Setubal, J. and Meidaris, J., Introduction to Computational Molecular Biology, Thomson 2003
2. Clote, P., and Backofen, R., Computational Molecular Biology, Wiley, 2002
3. Jiang T., Xu Y., Zhang M.Q.," Current Topics in Computational Molecular Biology", (MIT,2002), Ane Books 2004.
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 CS-710

Introduction- Issues in Real-Time Computing, Structure of Real-Time systems; Characterization of Real-Time systems – Performance Measures, Program run time estimation; Task scheduling –Uniprocessor Scheduling Algorithms, scheduling of IRIS task, task assignment; Real-Time database - transactions and concurrency control, disk scheduling algorithms, serialization, and hard real-time databases; Real-Time Communication – contention-based, token-based, polled bus, stop-and-go, round-robin, and deadline-based protocols; Fault-Tolerance Techniques – Cause of failure, fault types, fault detection, redundancy, data diversity.

Books:

1. C.M. Krishna and Kang G. Shin, *Real-Time Systems*, McGraw-Hill, 1997.
2. A. Tenanbaum, *Real-Time Sysems*, Pearson Education, 2002

Compiler Construction CS-711

Overview of a compiler; Lexical Analysis and LEX; Syntax Analysis: CFG's Ambiguity, Associativity, Precedence, Top-Down Parsing, Predictive Parsing, Bottom Up Parsing, Operator Precedence Grammar, LR Parser (SLR, LALR, LR), YACC; Syntax Directed Translations; Type Checking; Run Time Environments; Intermediate Code Generations: Declarations, Assignments, Control Flow, Boolean Expressions, arrays, Case Statements, Procedure Calls; Code Generations; Code Optimization: Optimization of Basic Blocks, Data flow analysis of Structured flow Graphs and data Flow Algorithms.

Books:

1. Aho, Sethi and Ullman," Compiler: Principles techniques and Tools:, Pearson education.
2. Holub, " Compiler Design in C", Prentice Hall
3. Aho and Ullman'" Theory of Parsing Translation and Compiling", Vol I and Vol II, Prentice Hall.

Optimization Techniques CS-712

erview of Optimization: Linear programming – Formulation, Simplex Method, Interior oint Methods, Duality and Sensitivity Analysis, Integer Programming - Branch and Bound methods, Dynamic Programming, Multi-objective Optimization and Goal Programming, Discrete Optimization Models - Relaxation methods; Simulated Annealing and Genetic Algorithms; Constrained Non-linear programming – Lagrange Multiplier Methods, Karush-Kuhn-Tucker Optimality conditions, Penalty and Barrier Methods, Reduced Gradient Methods, Quadratic and Separable Programming Methods; Unconstrained Non-linear Programming – Gradient Search, Newton Method

Books

1. Rao S.S.," Optimization - Theory and Applications", Wiley Eastern.
2. Beightler C.S,Phillips D.T, Wilde D.J.," Foundations of Optimization" PHI.
3. Rardin, R.L., Optimization in Operations Research, Pearson Education
4. Chong, E.K.P., Zak, S.H., An Introduction to Optimization, John Wiley and Sons

System Modeling and Simulation CS-713

1. Characterizing Systems, Models of a System, Concept of Simulation
2. Modeling Dynamic Systems - Discrete Delay, Distributed Delays
3. Discrete Event Simulation - Example: Queuing System, Inventory, Insurance Risk
4. Random Number Generation, Tests for Random Numbers, Inverse Transform Techniques, Acceptance - Rejection Technique
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
7. Markov Chain Monte Carlo Methods - Hasting's Metropolis Algorithm, Gibbs Sample, Simulation Encoding.

Books:

1. Severance Frank L," System Modeling and Simulation", Wiley, 2005.
2. Ross Sheldon M," Simulation", 3rd Edition, Academic Press 2002
3. Banks J., Carson J.S., Nelson B.L., Nicol D.M.," Discrete Event System Simulation", Pearson Education, 2002.
4. Law A.M., Kelton W.D.," Simulation Modeling and Analysis", 3rd Edition, 2000, MacGraw Hill.

Group - II

Machine Learning CS-714

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.

1. Mitchell, " Machine Learning ", Macgraw Hill, 1997.
2. Mitchalski, Carhonell and Mitchell," Machine Learning- An Artificial Intelligence Approach", Vol I - IV, Springer Verlag.
3. Adeli and Hung," Machine Learning- Neural Networks, Genetic algorithms and Fuzzy Systems", John Wiley and Sons.

Data Mining and Knowledge Discovery CS-715

Introduction and review of Graph Theory, Lattices, Probability and Statistics, Supervised and unsupervised learning, Search, Concepts of data mining and knowledge discovery: Input – concepts, instances, attributes; Knowledge representation of outputs; Data mining methodologies – classification, prediction, regression, association, clustering, outlier analysis

Advanced data mining models – machine learning: incremental learning, reinforcement learning, genetic algorithms, neural networks, intelligent agents based; Hybrid models: Rough set theory, Fuzzy sets.

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:

1. Han, J. and Kamber, M., Data Mining: Concepts and Techniques, Morgan Kaufmann, 2001.
2. Witten, Ian H. and Frank Eibe, Data Mining: Practical Machine Learning Tools and Techniques with Java Implementations. Morgan Kaufmann 1999

Reference Books:

1. Pujari, A. K. Data Mining: Techniques, University Press. 2001
2. Hand, David, Mannila Heikki and Smyth Padheaic, Principles of Data Mining, Prentice-Hall India, 2004 (Indian reprint)
3. Thuraisingham, B., Data Mining: Technologies, Techniques, Tools, and Trends, CRC Press, 1999.
4. Mitra, Sushmita and Acharya, Tinku, Data Mining: Multimedia, Soft Computing and Bioinformatics, John Wiley & Sons (Wiley Student Edition) 2004
5. Mitchell, Tom M., Machine Learning, McGraw-Hill International Edition 1997
6. Jang, J.-S.R. Sun, C.-T and Mizutani, E., Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, Pearson Education (LPE), First Indian reprint 2004
7. Russell, Stuart and Norvig, Peter, Artificial Intelligence: A Modern Approach, Pearson Education (LPE) e2, Fourth Indian reprint 2004

Data Warehousing CS-716.

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.

1. Pooniah P.," Data Warehousing Fundamentals", Wiley.
2. Kimball R. and Ross M.," The Data Warehouse Toolkit", Wiley
3. Inmon W.H.," Building the Data Warehouse", Wiley
4. Singh H.S.," Data Warehousing", Prentice Hall.

Image Processing and Computer Vision CS-717

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 Geomatric Transforms.
3. Image Enhancement, Restoration and Compression: Linear and Non Linear stretching, Histogram Specification, Image Averaging, Filtering, Constrained Least square Restoration, Maximum Posterior Estimation, Lossy Compression, Loss less Compression.
4. Image analysis: Segmentation, Thresholding, Edge and Line Detection, Derivative Operators, Corner Detection, Feature Extraction, Topological and Geomatrical Attributes.
5. Recognition: Shape Distance Measures, Template Matching, Clustering, Statistical Classification, Syntactic Recognition, Graph Matching.

Books:

1. Jahne B.,"Digital Image Processing", 5th edition, Springer.
2. Chanda B., Mazumdar Dutta D.," Digital Image Processing and Analysis", PHI, 2003
3. Gonzalez and Woods," Digital Image Processing", Pearson Education, 2002
4. Sonka Hlavu, Boyle," Image Processing, Analysis and Machine Vision", Thomson, 1999.

Wireless Communication and Mobile Computing CS-718

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:

1. T.S. Rappaport, *Wireless Communications – Principles and Practice*,, 2nd ed. Pearson Education, 2002.
2. William Stallings, *Wireless communications and Networks*, Pearson Education, 2002.
3. William C.Y. Lee, *Mobile Communication Engineering – Theory and Applications*, 2nd ed. McGraw-Hill, 1998

Performance Modeling of Communication Networks CS-717

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.

3. Network of Queues- Product form Solution: Open Network, Closed Queuing Networks.
4. Multiplexing: Network Performance and Service Characterization; Deterministic Network Analysis- Traffic Models and Calculus; Stochastic Traffic Models
5. Circuit Multiplexed Networks- Multi class Traffic. Overflow and Non Poisson Traffic, Blocking Probability, Internet's adaptive Window Protocol, Stochastic Model for a wide area TCP Connection. Multiple access: Wireless Network(IEEE 802.11).
6. Switching: Queuing in Packet Switching, Blocking in Switching Networks.
7. Routing: Algorithms for Shortest path, Routing Protocols.

Books:

1. Robertazzi T.G.," Computer Networks and Systems (Queuing Theory and Performance Evaluation)", Springer 2002.
2. Kumar Anurag, Manjunath D., Kuri J.," Communication Networking (An Analytical approach)", Morgan Kauffman, 2004
3. Fortier P.J., Michel H.E.," Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.

Mobile Ad Hoc Networks CS-720

'acket Radio networks –Technical challenges, Architecture, components, routing in RNETs, route calculations; Ad Hoc Networks –application, heterogeneity of mobile evices, traffic profile, sensor networks, challenges facing Ad Hoc networks; Media .ccess protocols – Hidden terminal problem, exposed terminal problem, MACA, MACA-I, PAMAS, DBTMA; Routing protocols – topology-based, and position-based, multicast)uting; Mobility and location Management – mobility models, location update strategies; nergy Conservation Issues – device power management, protocol power management; erformance of Ad Hoc networks

)oks:

1. C.K. Toh, *Ad hoc Mobile Wireless Networks – Protocols and Systems*, Prentice Hall, 2002
2. C.E. Perkins (ed), *Ad Hoc Netwoks*, Addison Wesley, 2001.
3. Ivan Stojmenovic (ed), *Handbook of Wireless Networks and Mobile Computing*, John Wiley, 2002

Optical networks CS-721

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

s:

1. R.Ramaswami, K.Sivarajan, "Optical Networks: A Practical Perspective", 2nd Edition, Elsevier (low-cost edition), 2002.

2. Thomas E. Stern, Krishna Bala , "Multiwavelength Optical Networks: A Layered Approach", Prentice Hall, 1999.

3. Greg Bernstein, Bala Rajagopalan, Debanjan Saha, "Optical Network Control: Architecture, Protocols, and Standards (Hardcover)", Addison-Wesley, 2003.

Embedded Systems CS-722

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

2. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", John Wiley.

Cryptography CS-723

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 Residuosity Property, Formal Definition of One-Way Functions, Hard-Core Predicates

Provably Secure Encryption and Digital Signatures: Perfect Secrecy and Probabilistic Attacks, Public-Key, One -Time Pads, Computationally Secret Encryption Schemes, Unconditional Security of Cryptosystems, Claw-free Pairs and Collision-Resistant Hash Functions, Authentication Tree Based Signatures, A State Free Signature Scheme

Books:

1. Introduction to Cryptography -Principles and Applications, Hans Delfs And Helmut Knebl, Springer (2003)
2. Cryptography and Network Security -Principles and Applications, William Stallings, Pearson Education (2004)

Pattern Recognition CS-724

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...ction: Pattern Recognition Systems, Supervised/Unsupervised Learning, ...forcement Learning

...atistical Pattern Recognition: Introduction to Statistical Pattern Recognition, The ...esian Case and Class Dependence, Discriminant Functions, Classifier Performance, Risk, and Errors

Supervised Learning Using Parametric and Nonparametric Approaches: Parametric Estimation and Supervised Learning, Maximum Likelihood Estimation, Bayesian Parameter Estimation Approach, Supervised Learning Using Nonparametric Approaches, Parzen Windows

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 Backpropogation Algorithm, Radial Basis Function Network, Hopfield Nets, Kohonen Network

Books:

1. Pattern Recognition Statistical, Structural and Neural Approaches, R. Schalkoff (Wiley)
2. Pattern Classification, R. O. Duda, P. E. Hart and D. G. Stork, Second Edition (Wiley)
3. Pattern Recognition and Image Analysis, E. Gose, R. Johnsonbaugh and S. Jost, (PHI)

Computational Finance CS-725

1. Basic Functional Mathematics- Time Value of Money, Annuities, Yields, Bonds, Bond Price Volatility, Term Structure of Interest rates.
2. Option Basics, Exchange traded options, Arbitrage in option pricing, Relative option prices, Put-Call parity and its consequences.
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:

1. Y.D.Lyuu," Financial Engineering and Computation", Cambridge university, 2002.
2. Ross S.M.," An elementary introduction to mathematical finance", Cambridge University, Second Edition

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VLSI Technology CS-726.

2. Basics of Semiconductor Physics, Modeling Bipolar Device Phenomena, MOSFET Modeling, Passive devices & Parameter Measurement .
   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, Metalisation techniques
4. Circuit implementation of simple combinational and sequential circuits.
5. Layout Compactation, Floorplanning, Routing.
6. Basic concepts of hardware description language VHDL

Books:

1. Kang S. M. and Leblebici, Y. "CMOS Digital Integrated Circuit: Analysis and Design" Mc.Graw Hill
2. Sarrafazadeh M. and Wong C. K. " An introduction to VLSI Physical Design" Mc Graw hill
3. Bhasker," VHDL primer", PH India
4. Ken Martin, "Digital Integrated Circuits", Oxford press.
5. Gerez," Algorithms for VLSI Design Automation", Wiley,2000.

Multimedia Systems CS-727.

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:

1. Ze-Nian, Li Marks, and S. Drew, *Fundamentals of Multimedia*, Person Education, 2004.
2. K.R. Rao, Z.S. Bojkovic, and Dragorad A. Milvanovic, Multimedia Communication Systems: Techniques, standards, and networks, Pearson Education, 2002.

Distributed Databases CS-728.

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

.s:

1 Ceri, S., Pellagati, G., Distributed Databases Principles and Systems, McGraw-Hill International
2. Ozsu, M.T., Valduriez, P., Principles of Distributed Database Systems, Second Edition, Pearson Education.

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 Criterions, 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:

2. Pressman, R., Software Engineering – A Practitioners Approach, Sixth Edition, McGraw-Hill International Edition
3. Ghezzi, C., Jazayeri, M., Mandrioli, D., Fundamentals of Software Engineering, Second Edition, Pearson Education
4. Peters, J.F., Pedrycz, W., Software Engineering-An Engineering Approach, John Wiley and Sons
5. Jalote, P., An Integrated Approach to Software Engineering, Second Edition, Narosa Publishing Housing
6. Sommerville, I., Software Engineering, Sixth Edition, Pearson Education
7. Taha. H.A., Operations Research-An Introduction, Seventh Edition, Pearson Education.

COMPUTER GRAPHICS CS-730

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, Berier and B-Spline Curves and Surfaces
- Animation, Simulation of Acceleration

REFERENCES

5. Hearn and Baker, "*Computer Graphics*", Pearson Education
6. Rogers, "*Procedural Elements for Computer Graphics*" Tata McGraw Hill, 2nd Edition
7. Rogers and Adams, "*Mathematical Elements of Computer Graphics*", Tata McGraw Hill
8. Foley, Vandam, Feiner and Hughes, "*Computer Graphics*" Pearson Education.

CS 731 # 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:

1. Pressman, R., Software Engineering – A Practitioners Approach, Sixth Edition, McGraw-Hill International Edition
2. Ghezzi, C., Jazayeri, M., Mandrioli, D., Fundamentals of Software Engineering, Second Edition, Pearson Education
3. Jalote, P., An Integrated Approach to Software Engineering, Second Edition, Narosa Publishing Housing
4. Sommerville, I., Software Engineering, Sixth Edition, Pearson Education
5. Peters, J.F., Pedrycz, W., Software Engineering-An Engineering Approach, John Wiley and Sons
6. Taha. H.A., Operations Research-An Introduction, Seventh Edition, Pearson Education.

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M.Tech.

CS 732

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, Kurtowaski'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

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M.Tech.

CS-133

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 , Crossbar, Clos, Benes network, Shuffle exchange, Hypercube, PM2I network.

Simple addition on various network topologies, Recurrence computation, Matrix multiplication, Sorting networks0-1 Principle, Bitonic sorter, 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

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M.Tech.

CS-734

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

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CS- 733

Object Oriented Programming 3 credits

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:

1. Bjarne Stroustrup, The C++ Programming Language, 3rd, Pearson Education, 2006
2. Lipman, S. B. C++ Primer, 3rd ed. Pearson Education, 1999
3. Grady Booch, Object-Oriented Analysis and Design with applications, 2nd ed, The Addison-Wesley, 1994
4. Grady Booch, James Rumbaugh, I Jacobson, The Unified Modeling Language User Guide, 5th ed. 2004.

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CS-736

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

1. Axioms of Probability, Bayes' Formula,Expectations of Random Variables, Jointly Distributed Random Variables,Conditional Expectation,some applications – A list model, A random graph. Limit Theorems, Random Number Generation, Simulating continuous random variables, Monte Carlo Integration.

2. Information Theory, Measure of Uncertainty, Shannon's Measure, Entropy, Joint and Conditional Entropies, Mutual Information, Kullback-Leibler Directed Divergence, Coding Theory and Entropy.

3. Stochastic Processes and Specifications, Stationary Processes, Markov Chains, Markov Processes, Poisson Process, Renewal Process, Birth-and-Death Process, Elements of Queuing – M/M/1 queue etc., Random Walk, Brownian Motion.

4. Modeling with Linear Programming, Simplex Method, Dual problem, Integer Linear Programming [Branch and Bound Algorithm], Deterministic Dynamic Programming [Forward and Backward Recursions], Introduction to Nonlinear Programming.

Books:

1. S.M. Ross, introduction to Probability Models, 8th ed., Academic Press, 2004.

2. S. Karlin and H.M. Taylor, Introduction to Stochastic Modeling, 3rd ed., Academic Press, 1998.

3. J. Medhi, Stochastic Processes,2nd ed., New Age International, 1996.

4. T.H. Cover and J.A. Thomas, Eletments of Information Theory, John Wiley, 1991.