Syllabus
of
M. Tech. Computer Science and Engineering
<table>
<thead>
<tr>
<th>Subject code</th>
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<th>Teaching scheme</th>
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<td>CS501</td>
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<td>Seminar-I</td>
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<td>CS553</td>
<td>Advanced Computing Lab-I</td>
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Total Contact Hours / week = 26
Total Credits = 24

### M. Tech. Computer Science and Engineering

#### Semester - II

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<td>CS508</td>
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Total Contact Hours / week = 25
Total Credits = 24

1. Introduction: Mathematical notions and terminology of sets, sequences and tuples, functions and relations, graphs, strings and languages, Boolean logic – properties and representation, Definition, Theorems and Types of Proofs – Formal proofs, deductive, reduction to definition, proof by construction, contradiction, induction, counter-examples.  

2. Regular Languages: Finite automata, DFA, NFA, Equivalence of DFA & NFA. An application, Regular expressions and languages, applications.  


4. Turing Machine: Turing machines, variants of TMs, programming techniques for TMs, Restricted TMs, TMs and Computers.  


7. Computability: Primitive recursive functions, computable functions, examples, the recursion theorem.  

Text books:

1. Introduction to Theory of Computation – Michael Sipser (Thomson Nrools/Cole)

Reference books:

1. Introduction to languages and theory of computation – John C. Martin (MGH)
2. Discrete Mathematical structures with application to Computer Science – J.P. Tremblay and R. Manohar
3. Theory of Computer Science – E. V. Krishnamoorthy

Term Work:

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work is to be internally assessed.
1. **Divide and Conquer**: The general method, Binary search, Mergesort, Quicksort, Selection sort and analysis of these algorithms (4)

2. **Dynamic Programming**: The general method, Multistage graphs, All pair shortest paths, Optimal binary search trees, 0/1 knapsack, Reliability design, Traveling Sales person problem. (5)

3. **Basic Traversal and Search Techniques**: Game Tree; Traversal Techniques for Graphs – Breadth First Search & Traverse, Depth First Search & Traverse, AND/OR graphs; Connected components and Spanning Trees; Bi-connected components and Depth First Search. (4)

4. **Lower Bound Theory**: Comparison trees, Oracles and adversary arguments, Lower bounds through reductions. (6)

5. **NP Hard and NP Complete Problems**: Basic Concepts, Cook’s Theorem, NP Hard Graph Problems, NP Hard Scheduling Problems, NP-Hard Code Generation Problems. (5)


7. **PRAM Algorithms**: Introduction, Computational Model, Fundamental Techniques and Algorithms, Merging, Lower Bounds. (3)

8. **MESH Algorithms**: Computational Model, Packet routing, Fundamental algorithms, Merging, Computing the Convex Hull. (3)

Text Books:

3. The Design and Analysis of Computer Algorithms – Aho, Hopcraft & Ulman (Pearson Education)

Reference Books:


Term Work:

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work is to be internally assessed.
UNIT I

Research methodology: An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, Defining a Research Problem, Techniques involved in Defining a Problem.

UNIT II


UNIT III


UNIT IV

Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method Data Processing Operations, Elements of Analysis, Statistics in Research,

Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation.

UNIT V

Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important parameters limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parametric Test, Conversion of Chi to Phi, Caution inusing Chi-square test.
UNIT VI

Analysis of Variance and Co-variance ANOVA, One way ANOVA, Two Way ANOVA, ANOCOVA Assumptions in ANOCOVA, Multivariate Analysis Technique Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis

REFERENCE BOOKS:

4. “Research Methodology- A step by step guide for beginners”, Ranjit Kumar, Pearson Education
5. “Management Research Methodology-Integration of principles, methods and Techniques”, K.N. Krishna swami and others, Pearson Education
Unit I Introduction
Requirements, Network architecture, Networking principles, Network services and Layered architecture, Network services and Layered architecture, Future networks (Internet, ATM, Cable TV, Wireless – Bluetooth, Wi-Fi, WiMax, Cell phone)

Unit II Advanced Technologies
Virtual circuits, Fixed size packets, Small size packets, Integrated service, History, Challenges, ATM Network protocols, IP over ATM, Wireless networks: Wireless communication basics, architecture, mobility management, wireless network protocols. Ad-hoc networks Basic concepts, routing; Bluetooth (802.15.1), Wi-Fi (802.11), WiMAX (802.16), Optical Network: links, WDM system, Optical LANs, Optical paths and networks.

Unit III Performance of Networks

Unit IV Advanced Routing - I
Routing architecture, Routing between peers (BGP), IP switching and Multi-Protocol Label Switching (MPLS), MPLS Architecture and related protocols, Traffic Engineering (TE) and TE with MPLS, NAT and Virtual Private Networks (L2, L3, and Hybrid), CIDR — Introduction, CIDR addressing, CIDR address blocks and Bit masks

Unit V Advanced Routing - II
Unit VI Ad Hoc Networking

Text Books:

Reference Books:
2. A. S. Tanenbaum, “Computer Networks”, Publisher: Pearson Education;
5. W. R. Stevens ,”TCP/IP Illustrated, Volume 1,2,3”, Publisher: Pearson Education
UNIT-I


UNIT-II


UNIT-III

NEURAL NETWORKS: Supervised Learning Neural Networks Perceptrons - Adaline, Backpropogation, Multilayer Perceptron, Radial Basic Function Networks, Unsupervised Learning Neural Networks, Competitive Learning Networks, Kohonen Self Organizing Networks Learning Vectors

UNIT-IV


UNIT-V

APPLICATIONS OF COMPUTATIONAL INTELLIGENCE: Printed Characteristic Recognition, Inverse Kinematic Problems, Automobile Fuel Efficiency Prediction, Soft Computing For Color Recipe Prediction
TEXT BOOK:


REFERENCES:


1. **Introduction:** Evolution of Computer Architecture - Trends; Fundamentals of Parallel Computers; Need for multi-core architectures

2. **Parallel Programming:** Overview, Parallel programming design patterns, Multithreading goals and issues, OpenMP Directives – Parallel, work sharing, task, synchronization constructs & other directives, Exercises on Multithreading with OpenMP.

3. **Software Optimization & Performance Analysis:** Processor Architecture basics, Need for software optimization, Algorithms analysis, Performance analysis - Hot spots, Branching, Memory, Loops

4. **Benchmarking multi-core architecture:** Bench marking of processors. Comparison of processor performance for specific application domains.
Text Books:

1. The Software Optimization Cookbook; Richard Gerber, Aart J.C. Bik, Kevin B. Smith and Xinmin Tian; Intel Press.

2. Multi-Core Programming; Shameem Akhter and Jason Roberts; Intel Press.

References Books:

1. OpenMP Spec 3.0 handbook available on the Web

2. Lecture Notes & Web Reference

Term Work:

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work will be assessed internally.
1. Information and Management (8)
Types of information, why do we need a computer based information system? Management structure, Management and information requirements, qualities of information.

Examples of Information Systems
Various functions in organizations, Information processing for a store- An overview, Varieties of information systems.

Information Systems Analysis & Design Overview: Overview of design of an information system. The role and tasks of a systems analyst, Attributes of a systems analyst, Tools used by system analyst, System Development Life Cycle

2. Information Gathering (8)
Strategy to gather information, Information sources, Methods of searching for information, Interviewing techniques, Questionnaires, Other methods of information search, Case example-Hostel information system, System requirements specification: Example, Data dictionary, Steps in Systems Analysis, Modularizing requirements specifications, Conclusions.

3. Feasibility Analysis, Data flow diagrams (8)
Deciding on project goals, Examining alternative solutions, Evaluating proposed solution, Cost-benefit analysis, Pay back period, Feasibility report, System proposal, Symbols used in DFD’s Describing a system with a DFD, Good conventions in developing DFDs, Leveling of DFDs, Logical and Physical DFDs, Process Specifications - Process specification methods, structured English Some examples of process specification.

4. Decision Making (8)
Decision table terminology and development, Extended entry decision tables, Establishing the logical correctness of decision tables, Use of Karnaugh maps to detect logical errors in decision tables, Eliminating redundant specifications.

5. Control, audit and security of information systems (6)
Review of following standards – CMM, ISO 17799, ISO 27001, BS 7799
Text/Reference Books:


Term Work:

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work will be assessed internally.
It should consist of a talk of 40-45 minutes on a topic preferably from the area in which a student intends to work for his dissertation during Semester – III and Semester – IV. The report there-on is to be submitted which is assessed internally.
The term work should consist of 3-4 practical assignments each on the following subjects.

1. Mathematical Foundations of Computer Science
2. Design & Analysis of Algorithms
3. Advance Networks

The practical assignments are to be given and evaluated by the respective subject teacher. A common journal is to be prepared by individual student and duly signed by the respective teachers be submitted to the department at the end of the semester.
1. **Introduction to Database Design**: Overview of the design process, the Unified Modeling Language (UML), features of good relational designs, database-design process, database design methodology: conceptual, logical & physical database design. Case study: relational database design of enterprise system (5)

2. **Object Database System**: Motivation, structured data types, operations on structured data, encapsulation and ADTs, inheritance, objects OIDs and reference types, database design for ORDBMS, ORDBMS implementation challenges, OODBMS, comparison of RDBMS, OODBMS and ORDBMS. Case study: Object database design using Oracle / IBM DB2 (5)

3. **Semistructured Data and XML**: Semistructured data, introduction to XML, XML related technologies, XML Query Languages. Case study: Semistructured and XML data handling in Oracle / IBM DB2 (4)

4. **Security and Authorization**: Introduction to database security, access control, discretionary access control, mandatory access control, security for internet applications, additional issues related to security. Case study: Security and authorization in Oracle / IBM DB2 (4)

5. **Advanced Transaction Processing**: Transaction-processing monitors, transactional workflows, main memory databases, real-time transaction system, long-duration transactions, transaction management in multi-databases (5)

6. **Performance Tuning**: Various issues in performance tuning, performance benchmarks, standardization, application migration. Performance tuning in Oracle / IBM DB2 (4)

7. **Data Warehousing Design**: Designing a data warehouse database, dimensionality modeling, database design methodology for data warehouses, criteria for accessing the dimensionality of a data warehouse, data warehousing design using Oracle (5)

8. **Data Mining**: Introduction, counting co-occurrences, mining for rules, tree-structured rules, clustering, similarity search over sequences, incremental mining and data streams, Web Mining: web content mining & web usage mining. Case study: data mining tools in Oracle / IBM DB2 (5)
Text Books:

Reference Books:
2. Data Mining: Introductory and Advanced Topics – Margaret H. Dunham (Pearson Education)

Term Work:
1. It should consist of 10-12 design experiments based on above topics.
2. The thrust should be given to design, modeling and implementation using standard CASE tools.
3. Use C# as Programming Language. For database programming / scripting use PL/SQL in Oracle / IBM DB2.


5. Scalable Multiprocessors: Introduction, Scalability, Bandwidth Scaling, Latency Scaling, Cost Scaling, Physical scaling, Scaling in a Generic Parallel Architecture, Realizing Programming Models, Primitive Network Transactions, Shared Address Space, Message Passing, Common challenges, Communication architecture design space, Physical DMA, A Case Study: nCUBE/2, User-level Access, Case Study: Thinking Machines CM-5, User Level Handlers, Dedicated Message Processing, Case Study: Intel Paragon, Case Study: Meiko CS-2, Shared Physical Address Space, Case study: Cray T3D, Cray T3E, Summary, Clusters and


8. **Combinational search** : Divide & conquer, Branch & bound ,Parallel branch & bound algorithm, alpha- beta search, parallel alpha –beta search, Enumeration sort, lower bound of parallel sort odd –even transposition sort, merge ,quick sort base algorithm random read and random write complexity of parallel sort , searching on multiprocessor graph algorithm depth first breath first , shortest path minimum cost spanning tree. (4)

9. **Solving Linear System** : Back substituting odd even reduction ,Gaussian elimination the jacob algorithm ,Gauss Scidal algorithm ,Jacobi over relaxation & successive over relaxation multi grid method , conjugate gradient method. (3)

Text Books:
1. Parallel Computer Architecture A Hardware / Software Approach - David Culler University of California, Berkeley, Jaswinder Pal Singh Princeton University with Anoop Gupta Stanford University
2. Parallel Algorithm by Michel Queen Parallel Algorithm by Michel Queen

Reference Books:

Term Work:

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work is to be internally assessed.
1. Introduction: Speech & Natural Language Processing: Introduction; Brief Review of Regular Expressions and Automata; Finite State Transducers. (4)

2. Word level Morphology and Computational Phonology; Basic Text to Speech; Introduction to HMMs and Speech Recognition. (6)

3. Indian language case studies; Part of Speech Tagging; Parsing with CFGs; Probabilistic Parsing. (6)


5. Representation of Meaning; Semantic Analysis; Lexical Semantics; Word Sense Disambiguation; Discourse understanding; Natural Language Generation. (6)

6. Language modeling and Naive Bayes:

Text Books:
1. Speech and Language Processing, Daniel Jurafsky and James H. Martin, PHI

Reference Books:
1. Distributed Computing System Fundamentals: Introduction to distributed computing systems, Models, Distributed operating system, Design issues of distributed operating system. (2)


3. Remote Procedure Calls: RPC model. Implementing RPC mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication protocols for RPCs. (4)

4. Distributed Shared Memory: General Architecture of DSM systems. Design and implementation issues of DSM, Granularity, Structure of Shared Memory Space, Consistency models. (4)

5. Resource Management: Features of global scheduling algorithm, Task assignment approach, Load-Balancing and Load-sharing approach. (3)


**Text Books:**

2. Distributed Systems Concepts & Design by George Coulouris, Jean Dollimore & Tim Kindberg (Pearson Education)

**Reference Books:**

3. Modern Operating Systems – Singhal

**Term Work:**

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work is to be internally assessed.
1. Introduction: Fundamentals of wireless communication technology, the electromagnetic spectrum, radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet. (7)

2. Introduction to adhoc/sensor networks: Key definitions of adhoc/sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering. (6)

3. MAC Protocols: Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4. (7)


5. QoS and Energy Management: Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes. (8)
TEXT BOOKS
2. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004

REFERENCE BOOKS
2. William Stallings, "Wireless Communications and Networks ", Pearson Education – 2004

Term Work :

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work will be assessed internally.


5. **Sensing 3D shape**: how the 3rd dimension changes the problem. Stereo 3D description, 3D model, matching, TINA, Direct 3D sensing-structured light, range finders, range image segmentation Emerging IT applications: Recognition of characters, Fingerprints and faces-Image databases. (7)
Text Books
2. Image Processing and machine vision-Milan Sonka,Vaclav Hlavae

Reference Books
1. Pattern Recognition Principles-J.T. Tou and R. C. Gonzalez
2. Syntactic Pattern Recognition and applications. King Sun Fun
3. Computer vision-Fairhurst (PHI).

Term work
It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work will be assessed internally.
M. Tech (COMPUTER SCIENCE & ENGINEERING)
Elective-II
CS514 Bioinformatics
Sem–II

1. Introduction: (8)

Biology in the computer age, computing changes in biology, Bioinformatics just about building database, Meaning of informatics to biologists, challenges offered by biology to computer scientists, skills required for this field, Available information & software for this domain, use web information, understand sequence alignment data, writing programs to align two biological sequences, predict protein structure from sequence, questions bioinformatics can answer, Watson’s Definition, Information Flow, Human Genome project.

2. Tools for Bioinformatics: (8)

Biological Research on the web, Using search engines, finding scientific articles. Public biological databases, Searching biological databases, Depositing data into the public databases, finding software, Judging the quality of information

Sequence Analysis, Pair-wise alignment& Database searching: Chemical composition of bio-molecules, Composition of DNA & RNA, Watson & Crick Solve structure of DNA, Development of DNA sequencing methods, Gene finders & feature detection in DNA, DNA translation, Pair wise sequence comparison, Sequence queries against biological databases, Multifunctional tools for sequence analysis.

3. Multiple sequence Alignments, Trees & profiles: (8)

The morphological to the molecular, Multiple sequence alignment, Phylogenetic analysis, Profiles & motifs.

Predicting protein structure & function from sequence: Determining the structure of the proteins, Prediction the structure of proteins, from 3D to 1D, Feature detection in protein sequences, Secondary structure prediction, Predicting 3D structure.

4. Tools for Genomic & Proteomics: (6)

From sequencing genes to sequencing genomes, Sequence assembly, Accessing genome information on the web, Annotating and analyzing whole genome sequences, Functional genomics new data analysis challenges, Proteomics, Biochemical pathway databases, Modeling kinetics & physiology.
Visualization and Data Mining: Preparing your data, Viewing graphics, Sequence data visualization, Networks and pathway visualization, working with numerical data, Visualization: summary, Data mining & biological information

5. Building a sequence search protocol:

Introduction, A practical approach, when to believe a result, Structural and Functional interpretation.

Analysis packages: Introduction - What is in analysis package? Commercial Databases Comprehensive packages, Packages specializing in DNA analysis. Intranet packages, Internet packages, web addresses.

Text / Reference Books:

2. T K Attwood D J Parry-Smith, “Introduction to Bioinformatics”, (Pearson Education)

Term work

It should consist of 10-12 assignments based on the syllabus. The students should be assigned at least 1 or 2 assignments of analyzing relevant articles from International journals and are further supposed to submit a report containing the analysis, alternatives in the design or solution, suggestions regarding improvements on the topics chosen. The term work will be assessed internally.
It should consist of a talk of @ 40-45 minutes on a topic preferably from the area in which a student intends to work for his dissertation during Semester – III and Semester – IV. The report there-on is to be submitted which is to be assessed internally. The student should finalize his dissertation topic as an outcome of Seminar-II.
The term work should consist of 3-4 practical assignments each on the following subjects.
1. Design of Database Systems
2. Parallel Algorithms & Design
3. Advance Distributed System

The practical assignments are to be given and evaluated by the respective subject teacher. A common journal is to be prepared by individual student and duely signed by the respective teachers be submitted to the department at the end of the semester.