M.Tech (ADVANCED COMPUTING)

SEMESTER I

AC 511 MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

Logic: Basics of propositional and first order logic, Completeness and compactness results;

TOC: Universal Turing Machines, undecidability, Rice's theorems for RE sets, Post machines, Basics of recursive function theory. Equivalence, Church's thesis, Computational complexity, Space and Time complexity of Turing Machines, Relationships, Savage's theorem, Complexity Classes, Complete problems, NP – completeness, Cook-Levin theorem.

References

1. Introductionto Automata Theory, Languages and Computation, J. E. Hopcroft, J. D. Ullman.
2. First-Order Logic, Raymond M. Smullyan,
3. Structural Complexity, J.L. Balcazar, J. Diaz, J. Gabarro,

Course Outcomes

1. To develop the skills for solving mathematical problems in computer science.

2. To learn analysis and design of Turing Machines.

AC 512 ADVANCED DATA STRUCTURES

Review of algorithm analysis, Optimal Binary search trees, Balanced binary search trees, Binary heaps, Advanced heap structures, Binomial heaps, Fibonacci heaps. Amortized analysis, Splay trees. Dictionaries, Disjoint set structures. Data Structures for External Memory, External sorting, String matching. Introduction to Randomized Data structures and algorithms.

References

1. Introduction to algorithms Cormen and Rivest
2. Randomized algorithms R.Motwani and P. Raghavan

Course Outcome

1. Basic ability to analyze algorithms and to determine algorithm correctness and time efficiency class.
2. Master a variety of advanced abstract data type (ADT) and data structures and their implementations.
3. Master different algorithm design techniques
4. Ability to apply and implement learned algorithm design techniques and data structures to solve problems.

AC 513 ARCHITECTURE OF LARGE SYSTEMS

Pipeline processor principles and design, Instruction set architecture; Memory addressing; Instruction composition; Instruction-level parallelism. Hazards: dynamic scheduling, branch prediction; Memory hierarchy; Processor case studies; Multiprocessor introduction: Shared-memory architectures and their synchronisation and consistency issues, Advanced multi-core topics; Transactional Memory; Interconnection networks.

Books

1. J. L. Hennessy and D. A, "Computer Architecture: A Quantitative Approach".

References

1. David Culler, J.P. Singh and Anoop Gupta, "Parallel Computer Architecture: A Hardware/Software Approach".
2. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, Programmability".

Course Outcome

This course describes the principles of computer design and classifies instructions set architecture, at the end students will be able to

1. Describe the operations of performance such as pipelines, dynamic scheduling branch predictions, caches.
2. Describe the operations of virtual memory.
3. Describe the modern architecture such as RISC, Scalar, VLIW Multi core and multi CPU systems.
4. Compare the performance of different CPU architecture.
5. Develop the applications for high performance computing systems.

AC 516 SEMINAR - I

Students have to collect an International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure

M.Tech (ADVANCED COMPUTING)

SEMESTER II

AC 521 HIGH PERFORMANCE SCIENTIFIC COMPUTING

Overview of parallel system organization; Introduction to message passing and MPI programming; Embarrassingly parallel problems; Problem decomposition, graph partitioning, and load balancing; Introduction to shared memory and OpenMP programming; Examples of scientific computing; Parallel Languages.

References:

1. Parallel Programming for Multicore and Cluster Systems by Thomas Rauber and Gudula Runger.
2. Scientific Parallel Computing by Scott, Clark, and Bagheri.
3. Using OpenMP: Portable Shared Memory Parallel Programming by Chapman, Jost, and van der Pas.

Course Outcomes:

1. Learning about different parallel programming techniques.
2. Learning about the programming languages for parallel computation.

AC 522 GRAPH THEORY & ALGORITHMS

Graph Basics; Planner Graphs; Optimization and Matching; Connectivity of graphs; Graph Colouring; Graph representations.
Warshall's Algorithm; Depth-First and Breadth-First Searches; Dijkstra's Algorithm; Floyd's Algorithm; Kruskal's and Prim's Algorithms; Travelling Salesman's Problem; K shortest Path Algorithms.
Maximum Matching in Bipartite Graphs: The Hungarian Algorithm; Maximum Flow in a Transport Network: The Ford–Fulkerson Algorithm

References:

1. Graph, Network and Algorithm Dieter Jungnickel
2. Graph Theory with applications J ABondy and U S R Murty.

Course Outcomes:

1. Understand basic concepts in graph theory
2. Design and analysis of solutions for problems using graphs.
3. Learning various graph based algorithms.

AC 523 SOFT COMPUTING

Introduction to neural networks, Working of an artificial neuron, Perceptron, Back propagation algorithm, Adalines and Madalines. Supervised and unsupervised learning, Counter-propagation networks, Adaptive Resonance Theory, Kohonen's Self Organizing Maps, Neocognitron, Associative memory, Bidirectional Associative Memory. Introduction to fuzzy logic and fuzzy sets, fuzzy relations, fuzzy graphs, fuzzy arithmetic and fuzzy if-then rules, Process control using fuzzy logic, Decision-making fuzzy systems, Applications of fuzzy logic, Hybrid systems like neuro-fuzzy systems. Evolutionary Computation: Population-based Search: genetic algorithms and evolutionary computation, Genetic Programming. Swarm optimization, Ant colony optimization. Search techniques like Simulated Annealing, Tabu search etc.

References

1. F.O.Karray and C De Silva, "Soft Computing and Intelligent Systems Design"
2. Rajsekaran and Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms".

Outcome

At the end of this course students will be able to:

1. Have a thorough understanding of the following topics along with their applications
2. Understand concepts about ensemble based learning
3. Know how to apply Neural Networks and Genetic Algorithms to different problem areas

AC 526 SEMINAR-II

Students have to collect an International Journal paper on the topics of their interest, prepare a write up and present with suitable demonstration by software or experimental work. Evaluation will be based on relevant topic student has studied, communication skill and reporting/documenting procedure.

M.Tech (ADVANCED COMPUTING)

DEPARTMENT ELECTIVE I (SEMESTER I)

AC 531 DATA MINING

Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns, Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis; Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining;

References

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.
2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

Course Outcome

1. Study of different sequential pattern algorithms
2. Study the technique to extract patterns from time series data and it application in real world.
3. Can extend the Graph mining algorithms to Web mining
4. Help in identifying the computing framework for Big Data

AC 532 OPERATING SYSTEM & DESIGN

Computer system and operating system overview, Operating system functions and design issues, Design approaches, Types of advanced operating systems, Process abstraction, Process management, system calls, Threads, Symmetric multiprocessing and microkernels. Scheduling: Uniprocessor, Multiprocessor and Real time systems, concurrency, classical problems, mechanisms for synchronization: semaphores, monitors, Process deadlock and deadlock handling strategies, Memory management, virtual memory concept, virtual machines, I/O management, File and disk management, Operating system security. Distributed Operating system: architecture, Design issues, Distributed mutual exclusion, distributed deadlock detection, shared memory, Distributed scheduling. Multiprocessor operating systems: architecture, operating system design issues, threads, process synchronization, process scheduling, memory management, reliability and fault tolerance.

References

1. Advanced concept in operating system: M. Singhal, N.G Shivratri
2. Operating system internal and design princilples: William stallings

Course Outcome

1. Understanding functions, structures and history of operating systems
2. Understanding of design issues associated with operating systems
3. Understand various process management concepts including scheduling, synchronization, deadlocks

AC 533 WEB SEARCH & INFORMATION RETRIEVAL

Information retrieval model, Information retrieval evaluation, Searching the web, Document Representation, Query languages and query operation, Metadata search, Indexing and searching, Scoring and ranking feature vectors, Ontology, domain specific search, Parallel and distributed information retrieval, Text and multimedia languages, Social networks.

References

1. C. D. Manning, P. Raghavn and H. Schutze, "Introduction to Information Retrieval", Cambridge University Press, 2008 (pdf of book is available at http://nlp.standford.edu/IR-book).
2. Chakrabarti, S. (2002). Mining the web: Mining the Web: Discovering knowledge from hypertext data. Morgan-kaufman
3. B. Croft, D. Metzler, T. Strohman, Search Engines: Information Retrieval in Practice, Addison-Wesley, 2009 (available at http://ciir.cs.umass.edu/irbook/).
4. R. Baeza-Yates, B. Ribeiro-Neto, Modern Information Retrieval, Addison-Wesley, 2011 (2nd Edition).

Course Outcome

1. Introduce students to the concepts and techniques of Information Retrieval, Web Search, Data Mining, and Machine Learning for extracting knowledge from the web.
2. Develop skills of using recent data mining software for solving practical problems of Web Mining.
3. Gain experience of doing independent study and research.

AC 534 DIGITAL IMAGE PROCESSING

Introduction to Image Processing Systems, Digital Image Fundamentals:- Image model, Relationship between Pixels, Imaging geometry, Camera model. Image Sensing and Acquisition. Sampling and quantization. Image Enhancement and in spatial Domain: Point processing, Neighbourhood Processing, High pass filtering, High boost filtering, zooming. Image Enhancement based on Histogram medelling. Image Enhacement in frequency domain: 1D& 2D Fourier transform, Low pass frequency domain filter, High pass frequency domain filters, Homomorphics filtering. Image Segmentation:- Detection of discontinuation by point detection, line detection, edge detection. Edge linking and boundary detection:- Local analysis, global by graph, theoretic techniques. Thresh-holding. Morphology, Representation and description. Discrete image transform. Image Compression. Wavelet transformation.

References

1. Digital Image Processing Gonzalez & Wood
2. Digital Image Processing A.K.Jain
3. Image Processing Dhananjay K. Techkedath

Course Outcome

This course is designed to help the student to:

1. Apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.
2. Analyse and implement image processing algorithms.
3. Gain hands-on experience in using software tools for processing digital images.

AC 535 INTERNET OF THINGS (IoT)

Introduction to IOT, IOT Applications, RFID, Wireless Networks, Sensor networks, GPS, Devices and Gateways, Routing and data dissemination, Network Topologies, MAC, Data management. Development issues, Localizations, Time synchronization, IOT architectures, IOT System design and Tools

Text Book

No text book is recommended, subject will be taught using the material available on internet

References

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1stEdition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. JanHoller,VlasiosTsiatsis,CatherineMulligan,StefanAvesand,StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things:
4. Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.

Course Outcomes

1. To learn basics of IoT.
2. To learn unique characteristics and challenges of IOT
3. To Understand State of the Art – IoT Architecture.

M.Tech (ADVANCED COMPUTING)

DEPARTMENT ELECTIVE

II (SEMESTER I)

AC 541 Stochastic Process & Queuing Theory

Probability space, Random variables, Random vectors, Conditional distributions, probability mass function, Binomial, Poisson, exponential, normal, uniform distributions, Expectation. Inequalities. Characteristic function, Convergence of sequences of random variables. Types of convergences. Law of large numbers, Central limit theorem, stochastic processes, Classification of stochastic processes. Wide sense stationary. Point processes. Poisson processes. Markov chains, linear transformations of stationary processes, Stochastic Karhunen-Loeve expansions. Campbell Theorem.

Introduction of basic Queuing Theory, Birth-Death Processes, Simple Queuing Models (M/M/-/- Queues), Queues with Batch Arrivals, Discrete Time Queues, Delay Analysis of Queues. Fundamental of Queuing Networks, Open and Closed Queuing Networks, Open Networks of M/M/m type queues. Queuing System Applications, Simulation Modelling of Queuing Systems.

References

1. Donald Gross, James M. Thompson, John F. Shortle and Carl W. Harris, "Fundamentals of Queuing Theory", Wiley 2008.
2. Sanjay K. Bose, "An Introduction to Queuing Systems", Springer 2002.
3. T.G. Robertazzi, "Computer Networks and Systems - Queuing Theory and Performance Evaluation", Springer 2000.
4. L. Kleinrock, Queuing Systems Volume 1 : Theory, Wiley 1975.
5. Athanasios populis, "Probability Random variable and stochastic process", 3rd edition , MCGRAW Hill.
6. Kishor S. Trivedi, "Probability and Stochastic with Reliability queuing and Computer Science Application", 2nd edition Wiley India Publications.

Course Outcomes

1. This course is to provide the students basic knowledge about probability and stochastic process with applications.
2. The course will include permutation and combinations, probability theory, Random variable, probability mass function, Binomial, Poisson, exponential, normal, uniform distributions, stochastic process and Markov chains.
3. This course trains the student to model great

AC 542 INFORMATION THEORY & CODING

Information and entropy information measures, Shannon's concept of Information. Channel coding, channel mutual information capacity (BW),Theorem for discrete memory less channel, information capacity theorem, Error detecting and error correcting codes, Types of codes: block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques, Compression: loss less and lossy, Huffman codes, LZW algorithm, Binary Image compression schemes, run length encoding, CCITT group 3 1-DCompression, CCITT group 3 2D compression, CCITT group 4 2DCompression. Convolutional codes, sequential decoding. Video image Compression: CITT H 261 Video coding algorithm, audio (speech) Compression. Cryptography and cipher.

Course Outcomes

1. The aim of this course is to introduce the principles and applications of information theory.
2. The course will study how information is measured in
3. terms of probability and entropy.
4. The students learn coding schemes, including error correcting codes, The Fourier perspective; and extensions to wavelets, complexity, compression, and efficient coding of audio-visual information.

Textbook

- Fundamentals in information theory and coding, Monica Borda,Springer.
- Communication Systems: Analog and digital, Singh and Sapre, TataMcGraw Hill.
- Multimedia Communications Fred Halsall.

Reference books

- Information Theory, Coding and Cryptography R Bose.

Multimedia system Design Prabhat K Andleigh and KiranThakrar.

AC 543 COMPUTER & NETWORK SECURITY

Introduction to computer and network security. Basic concepts, threat models, common security goals, security policies, security mechanisms, Attacks, security tools, Cryptography and cryptographic protocols, Secret Key Cryptography , public-key cryptography, authentication, message authentication codes, hash functions, one-way functions, Message Digests , Hash And Mac Algorithms, secure channels. Malicious code analysis and defense. access control, digital signature standards (DSS), Kerberos, IPsec,Electronic Mail Security, X.509, Firewalls and Web Security, trusted system, intrusion detection systems, DoS attacks and defense, Cyber crime .

References

1. Cryptography and Network Security: Principles and Practice William Stallings

Course Outcome

1. Provide students with a high-level understanding of how information security functions in an organization.

AC 544 EMBEDDED SYSTEMS

Introduction, Hardware & electronics fundamentals, Peripherals, Program Design and Analysis, Processes and Operating system, Real time Operating system Memory, Interfacing, Examples of Embedded systems: Digital Camera Examples, Smart card application, Embedded database applications, etc State Machine and Concurrent Process Models, Control Systems Verilog programming, Programming of mobile and Hand-held devices. IC Technology Full-Custom (VLSI) IC Technology, Semi-Custom (ASIC) IC Technology, Programmable Logic Device (PLD) IC Technology, FPGA. Hardware Software Partitioning, Hardware/Software Co-Simulation, Intellectual Property Cores, Low Power design

References

1. Embedded system Design Frank Vahid, Tony Givargis
2. Computer as Components Wayne Wolf,
3. 8051 Microcontroller an Application Based introduction, Braithwaite Cowan,Parchizadeh
4. 8051 Microcontroller & Embedded Systems Rajiv Kapadia
5. The 8051 Microcontroller & Embedded Systems Mazidi & Mazida

Course Outcome

1. Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems.
2. Become aware of the architecture of the ATOM processor and its programming aspects (assembly Level)
3. Become aware of interrupts, hyper threading and software optimization.
4. Design real time embedded systems using the concepts of RTOS.
5. Analyse various examples of embedded systems based on ATOM processor.

M.Tech (ADVANCE COMPUTING)

DEPARTMENT ELECTIVE III

(SEMESTER II)

AC 551 CLUSTER & GRID COMPUTING

Basic concepts in Distributed Systems, Notion of time, Distributed Mutual exclusion, Consensus, Failure models, Paradigms for process interaction in distributed programs.

Cluster Computing: Introduction, Hardware for cluster computing, Software architectures for cluster computing based on shared memory (OpenMP) and message-passing (MPI/PVM) models, Performance evaluation tools, Configuring and Tuning Clusters.

Grid Computing: The Evolution Grid Technologies, Grid applications, Grid architecture, Grid relationship to other Distributed Technologies, Computational and Data Grids, Semantic grids.

Peer-to-Peer (P2P) Concepts in Grids: Introduction to P2P systems, Overlays, Unstructured P2P systems (Gnutella,Freenet), Structured P2P systems (Distributed Hash Tables - Chord, Pastry), Integrating unstructured and structured, P2P systems, Introduction to P2P security - Sybil attacks

Grid Management systems: Security, Grid-Enabling software and Grid enabling network services, Virtualization Services for Data Grids.

References

1. R. Buyya, High Performance Cluster Computing, Prentice Hall, USA, 1999.
2. Parallel Programming with MPI by Peter Pacheco, Morgan Kaufmann, 1998.
3. I. Foster and C. Kesselman, The Grid : Blueprint for a New Computing
4. Infrastructure, Morgan Kaufmann Publishers , 1999.
5. Grid Computing, D. Janakiram, Tata Mcgrahill, 2005.

Course Outcome

1. This course is an advanced elective and covers material relating to distributed computing fundamentals, grid computing middleware, and high performance applications.

2. The course covers the specific concepts of Cluster and Grid computing. It is presented the basic concepts of cluster, as a new approach of parallel and distributed processing system, which consists of a collection of interconnected standalone heterogeneous systems cooperatively working together as a single, integrated computing resource.

AC 552 NATURAL LANGUAGE PROCESSING

Regular Expressions and Automata, N-grams, Part-of-Speech Tagging, Hidden Markov and Maximum Entropy Models, Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification, Language and Complexity, The Representation of Meaning, Computational Semantics, Computational Lexical Semantics, Information Extraction, Question Answering and Summarization, Machine Translation

References

1. D. Jurafsky and J. Martin Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition.

2. C.Manning and H. Schutze , Foundations of Statistical Natural Language Processing

Course Outcome

1. Show sensitivity to linguistic phenomena and an ability to model them with formal grammars.
2. Understand and carry out proper experimental methodology for training and evaluating empirical NLP systems.
3. Be able to manipulate probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.
4. Be able to design, implement, and analyze NLP algorithms.

AC 553 SOFTWARE ENGINEERING

Software Project Management, Metrics and measurement, Software Configuration management, Software risk management, Requirements Engineering, Software quality assurance, software reliability models.

Object oriented design, object oriented programming (with C++), Formal specifications, Formal verification of programs, Jackson method for design, CASE tools and technology, Clean room method for software development, Information system design, Real-time software specification and design.

Enterprise architectures, Zachman"s Framework, Architectural styles, Design Patterns, Architecture Description Languages, Product-Line architectures, Component Based Development.

References:

1. An integrated approach to Software Engineering, Pankaj Jalote.
2. Software Engineering: A Practitioner approach Roger Pressman.
3. Software Architecture in Practice. Len Bass, Paul Clements, Rick Katzman, Ken Bass
4. Software Engineering, L. Pfleeger.1595. Pattern Oriented Software Architecture, Volumes 1 & 2 Stal, Doughlas Schmidt

Course Outcomes:

Student will be able to:

1. Understand the roles and activities in project management that promote secure software development.
2. Apply secure software design principles and the corresponding methods and tools for the secure implementation of those designs.
3. Relate standards of relevance to the area of secure software engineering, in particular to understand the advantages, roles, mechanisms, and difficulties involved in methods for evaluating assurance in security software.

AC 554 MACHINE LEARNING

Supervised Learning-Feature Selection, Cross Validation, Bootstrapping, Normalization Classification: Naïve Bayes, Bayesian Network, C4.5, ID3, Support Vector Machine, Extreme Learning Machine, Neural Network, VC Dimension, Regularization, Regression: Linear, Polynomial, Multiple Linear Regression, Support Vector Regression. Committee Machines/ Ensemble Learning: Bagging, Boosting. Unsupervised Learning-Clustering: K-Nearest Neighbour, K-Means, Fuzzy K-Means, Hierarchical Clustering, Single Linkage, Complete Linkage, Average Linkage, Non Spherical Clustering Algorithms. Statistical Testing Methods, Probabilistic Inference, Neural Network, Deep Learning Neural Network, Evolutionary Algorithms. Machine Learning Applications: Text Classification, Disease Diagnosis, Biometric Systems, Real Valued Classification.

References

1. Bishop, C. M. *(2006),* Pattern Recognition and Machine Learning, Springer, ISBN 0-387-31073-8
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar (2012) Foundations of Machine Learning, MIT Press ISBN 978-0-262-01825-8.
3. Mitchell, T. (1997). Machine Learning, McGraw Hill. ISBN 0-07-042807-7,

Course Outcome

1. To teach students what is Machine Learning?
2. To make students learn about the Theoretical/ Practical understanding techniques of machine learning algorithms.
3. To perform case study of various Machine Learning tools.
4. To perform case study of state of art problem and their possible solution using machine learning.

AC 555 PROFESSIONAL COMMUNICATION

Communication: A vital necessity for good management; Etiquettes Oral communication: Effective presentation skills; negotiation skills. Recruitment and selection, written test – structural, situational and psychological analysis, principles of interviewing reducing stress, retaining control, setting objectives for the interview, planning and preparation – the challenge of face to face skills.

Written communication skills: Netiquettes, writing resume, writing persuasive proposals and memorandum; planning and meetings, setting agendas for the meetings, writing and circulating minutes, notices.

Developing other skills – I: Leadership skills; time management skills; stress management, and emotional intelligence; development of an ideal mix of skills.

Developing Other Skills – II: Group communication: kinds of discussions – forum discussions, panel discussions, symposium discussion and group discussions.

Text Books & References

- Effective Business Communications – Murphy (Allied pub.)
- The Essence of Effective Communication - Ron Ludlow & Fergus Panton, (PHI)
- Effective Technical Communication – M Ashraf Rizvi, (Tata McGraw Hill)
- Personal Development of Life and Work – Wallace & Masters (Thomson Publishing)
- Communication in Organizations - Dalmar Fisher (Jayco Publishing)
- Technical Communication [A Reader Centered Approach] – Anderson (Cengage Publication)The Bass handbook of Leadership – Bernard and Ruth Bass
- Skillful Time Management – peter LevinEnglish for Engineers & Scientist – Sangeeta Sharma and Binod Mishra (Delhi: PHI)

Course Outcome

- Communicate effectively in written and spoken English to transfer complex knowledge and ideas to technical and nontechnical audiences.
- Identify and use appropriate sources of information when developing professional documents.
- Maintain and develop appropriate, effective and professional forms of documentation.
- Demonstrate effective team membership skills and contribute collaboratively within diverse team environments.
- Articulate and reflect on the industry expectations of competence and conduct in engineering and computing professions.

M.Tech (ADVANCE COMPUTING)

DEPARTMENT ELECTIVE IV

(SEMESTER II)

AC 561 DISTRIBUTED DATABASES

Introduction: Distributed Data processing, Distributed database system (DDBMSS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS. Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic Integrity Control. Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing. Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms. Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture. Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.

References

1. M.Tamer OZsu, Patrick Valduriez, "Principles of Distrubted Database Systems", Second Edition.
2. Distributed Databases principles and systems, Stefano Ceri,GiuseppePelagatti,TatamcGrawHill

Course Outcome

Students will have good knowledge of

1. The issues and challenges faced while designing distributed database systems.
2. Understand the fundamental principles and architecture of distributed database systems.
3. Familiar with the different methods and techniques distributed query processing.
4. Develop the understanding of choosing the optimized query execution plan for distributed queries.
5. Have a broad picture of distributed transaction management and concurrency Control and distributed DBMS reliability and replication techniques.
6. They will be able to design a multidatabase Systems and can resolve problems of heterogeneous multidatabase systems in database integration strategies.

AC 562 AD HOC & SENSOR NETWORKS

Introduction of ad-hoc/sensor networks: key definitions, advantages, unique constraints and challenges, applications, and wireless communications/radio characteristics. Media Access Control and routing protocols for Ad-Hoc wireless networks: issues, classification and protocols. Networking Sensors: features, deployment of sensor networks, sensor tasking and control. Sensor Network platforms and tools :Berkley Motes ,Sensor network programming challenges ,Embedded Operating System.
Transport layer, QoS issues and security protocols for ad hoc and sensor networks. Simulators for wireless ad hoc and sensor networks. Applications of Ad-Hoc/Sensor Network and Future Directions.

References

1. Ad hoc Wireless Networks C. Siva Ram Murthy & B. S. Manoj
2. Wireless Sensor Networks: An Information Processing Approach Feng Zhao and Leonidas J. Guibas.

Course Outcomes

1. Understand the unique issues in ad-hoc/sensor networks.
2. Understand current technology trends for the implementation and deployment of wireless ad-hoc/sensor networks.
3. Understanding the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks.
4. Understanding the challenges in designing routing and transport protocols for wireless Ad-hoc/sensor networks.

AC 563 SEMANTIC WEB

Detailed syllabus

The Semantic Web Vision, overview of techniques and standards, Semantic Web Architecture, XML with Document Type Definitions and Schemas, Transformation/Inference rules in XSLT, RuleML and RIF, metadata with RDF (Resource Description Framework); metadata taxonomies with RDF Schema; Ontology languages, Ontology Development using Protege editor, Ontology Querying, Ontology Reasoning and Description Logic (DL), Semantic Web Application Areas, Ontology programming with Jena API, Ontology Engineering**.**

References

1. Grigoris Antoniou and Frank van Harmelen, A Semantic Web Primer, 1st Edition, MIT Press, 2004.
2. John Hebeler, Matthew Fisher, Ryan Blace and Andrew Perez-Lopez, Semantic Web Programming, 1st Edition, Wiley, 2009

Course Outcome

At the end of the course the student will be able to:

1. Analyze the Semantic Web architectures
2. Perform Ontology reasoning
3. Apply Ontology programming using Jena-API
4. Develop Ontology using Protege Editor
5. Perform queries on Ontology

AC 564 PARALLEL ALGORITHMS

Parallel algorithms: Introduction, Terminology, Pipelining & data parallelism, Control parallelism, scalability.
PRAM algorithms: Serial and Parallel computation; Processor arrays, Multiprocessors & Multi-computers, Flynn's taxonomy, Speedup Scaled Speedup and Parallelizability. Parallel Programming Languages, Mapping & Scheduling;
Matrix Multiplication Algorithm: Sequential, Processor arrays, Multi-computers.
Fourier transform: Introduction, Discrete, Inverse discrete, Fast Fourier transform. Sorting algorithms, Dictionary operation, Graph algorithm, Combinatorial Search

References:

1. Parallel computing by Michael J. Quinn.
2. The Design of Parallel and Analysis Algorithms by Selim G. AkM.

Course Outcomes

1. To get knowledge of basics of parallel computing.
2. To get knowledge of parallel programming languages
3. Understanding different arallel algorithms

M.Tech (ADVANCE COMPUTING)

OPEN ELECTIVES

(SEMESTER I)

AC 571 DISTRIBUTED SYSTEMS

Definitions and Objectives, Issues in Distributed Computing, Distributed Computing Models, Inherent limitations; Introduction, Abstraction Layers, RPC Mechanisms, RMI, Naming Service, Message Passing Systems and Models; Concurrent programming concept, process migration, communicating sequential processes, Distributed Scheduling – Deadlocks and Dealing with Deadlocks; Extending mutual exclusion, Dijkstra's solutions, Lamport's DME Ricart and Agarwala's optimal algorithm for DME; Lamport's logical clocks and its limitation, Election Algorithms in Ring and broadcast networks; Classification - Byzantine Agreement problem, Consensus problem – Relationships – Applications; Architecture - Design and Implementation Issues - Algorithms for implementation Other approaches; Features - File Sharing Semantics, File Caching Schemes, File Replication, Design principles, Case Studies; Failure Classifications - Checkpoints, Synchronous and Asynchronous check pointing, Recovery, Commit protocols, Static and dynamic voting protocols; ACID Properties, Concurrency Control, commit protocols: 2PC, 3PC.

References

1. Hagit Attiya, Jennifer Welch, "Distributed Computing: Fundamentals, Simulations, and Advanced Topics", 2/E, Jon Wiley & sons, March 2004.
2. Nancy Lynch, "Distributed Algorithms", Morgan Kaufmann Publication, 1996.
3. Mukesh Singhal, Niranjan G. Shivaratri (Contributor), "Advanced Concepts in Operating Systems: Distributed, Database, and Multiprocessor Operating Systems", MGH, 1994.
4. Jim Farley, "Java Distributed Computing",1/E, 1998.
5. Michael Reilly, "Java Network Programming and Distributed Computing", Addison Wesley, 2002.

Course Outcome

1. To expose students to both the abstraction and details of file systems.
2. To provide students with contemporary knowledge in parallel and distributed computing.
3. To focus on performance and flexibility issues related to systems design decisions.
4. Introduce a variety of methodologies and approaches for reasoning about concurrent and distributed programs.

AC 572 OBJECT ORIENTED DESIGN & MODELING

Object Orientation, OMT Methodology, Object and Class, Link and Association Generalization, Aggregation Multiple Inheritance, Packages. Object Meta modelling, Metadata and Meta models, Functional Modelling. Pseudocode, Pseudocode with the Object Navigation Notation, ONN Constructs, combining ONN Constructs. Analysis: Object Model, Data Dictionary, Dynamic Model, Functional Model. System Design: Devising an Architecture, Database Management Paradigm, Object Identity, Policies for Detailed Design Dealing with temporal data. Detailed Design:- Object Model Transformations, Elaborating the Object Model, Elaborating the Functional Model, Evaluating the Quality of a Design Model

References

1. Object-Oriented Modeling and Design by Michael Blaha / William Premerlani, Prentice Hall

Course Outcome

Students will

1. be able to use an object-oriented method for analysis and design
2. be able to analyse information systems in real-world settings and to conduct methods such as interviews and observations
3. have a general understanding of a variety of approaches and perspectives of systems development, and to evaluate other IS development methods and techniques
4. Know techniques aimed to achieve the objective and expected results of a systems development process.
5. know different types of prototyping know how to use UML for notation

AC 573 OPTIMIZATION TECHNIQUES

Introduction: Maximization and minimization problems- examples. Basic concept of optimization – Convex and concave functions, Necessary and sufficient conditions for stationary points. Degree of freedom. Formulation: Economic objective function. Formulation of various process optimization problems and their classification. Optimization of unconstrained and constrained search: Optimization of one dimensional function, unconstrained multivariable optimization direct search methods. Indirect first order and second order methods, constrained multivariable optimization - necessary and sufficient conditions for constrained optimum. Linear programming and applications: Geometry of linear programs, Simplex Algorithm its applications. Non- linear programming with constrained and its applications: Quadratic programming, Generalized reduced gradients methods, Successive linear and successive quadratic programming, Dynamic programming, Integer and mixed integer programming. Application of optimization in chemical engineering: Optimization of staged and discrete processes, Optimal shell-tube heat exchanger design, Optimal pipe diameter, Optimal design of an Ammonia reactor. Nontraditional optimization techniques: Introduction and application areas.

References

1. Optimization of Chemical Process Edger T. F. and Himmelblau D. M
2. Optimization Theory and Practice Beveridge G. S. and Schechter R. S .
3. Engineering Optimization Methods and Applications Rekllaities F. V., Ravindan A. and Ragsdell K. M.
4. Engineering Optimization Rao S.

Course Outcome

1. The student will learn to handle, solve and analyzing problems using linear programming and other mathematical programming algorithms.

2. The students will also be able to learn different techniques to solve Non- Linear Programming Problems.

3. They can also use search techniques methods, which are based on iterative methods, to find optimal solutions of Non-Linear Programming Problems. Also students will be able to understand multistage decision problems.

AC 574 CLOUD COMPUTING

Cloud Computing: Introduction, Working of cloud computing, benefits; Understanding Cloud Computing: Developing cloud computing services, Discovering cloud services; Cloud Computing for Everyone: Centralizing email communications, Cloud computing for community; Cloud Computing for the Corporation: Managing Schedules, Managing Projects; Using Cloud Services: Collaborating on Calendars, Schedules, and Task Management, Collaborating on Project Management. Outside the Cloud: Other Ways to Collaborate Online: Collaborating via Web-Based Communication Tools, Collaborating via Social Networks and Groupware.

Case Study: Vitualization (Xen, VMWare, Amazon EC2), Different Service Models – Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS).

References

1. Michael Miller, "Cloud Computing", Pearson Education, New Delhi, 2009.
2. Implementing and Developing Cloud Computing Applications by DAVID E.Y. SARNA, CRC Press

Course Outcome

1. To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
2. Knowledge of different service model will be useful to understand how cloud based services are offered by existing cloud player.

AC 575 SUPPORT VECTOR MACHINE

Fundamentals of classification and Regression, Hard-margin and soft-margin SVMs, concepts of kernels and feature spaces, basics of optimization and quadratic programming ,elements of statistical learning theory and generalization theory, implementation issues, SMO algorithm, selected advanced topics (multi-classification, support vector regression) , Application of SVM to real life classification and regression problems.

References:

1. Learning with Kernels, B. Schölkopf, A. J. Smola (2002)
2. Support Vector Machines for Pattern Classification, S. Abe (2005

Course Outcomes: The focus of this course is on obtaining practical experience with using SVMs and on understanding the core concepts the theory is built on.

1. There are many free SVM libraries available, as well as commercial packages. After this course, students will be able to pick any of these tools, and use them correctly (and optimally) in their research fields.
2. Not as a black-box, but with understanding of the inner-workings, being aware of potential issues that may occur.

M.Tech (ADVANCE COMPUTING)

OPEN ELECTIVE II

(SEMESTER II)

AC 581 IMAGE ANALYSIS

Document Analysis and Recognition: handwriting, signatures, etc., physical and logical structures of documents, Document Image Processing, Document Models, Handwriting Models and Analysis and recognition, Multi-lingual Processing, Physical and Logical Analysis,- Graphics Recognition, Map and Line Drawing Understanding, etc

Text Analysis and Processing, Natural Language Issues, Information Extraction and Filtering, Performance Evaluation, Document Authentification and Validation,

Medical Image Analysis: molecular/cellular imaging to tissue/organ imaging, computational anatomy (modelling normal anatomy and its variations), computational physiology (modelling organs and living systems

Satellite image acquisition techniques, Remote Sensing, Image Pre-processing, Image enhancement, Image Registration, Spatial Feature Extraction, Image classification, applications

Reference:

1. Rees, W.G., Physical Principles Of Remote Sensing, Cambridge University Press, 2001.
2. Lillesand T.M., and Kiefer R.M., Remote Sensing and Image Interpretation, Fourth Edition, Wiley, 1999.
3. P.M. Mather, Digital Image Processing of Remotely sensed Images, Wiley, 2004.
4. John R. Jensen, Digital Image processing: A Remote Sensing Perspective, Prentice-Hall, 2004.

Course Outcomes:

1. To learn how satellite images are acquired and processed.
2. To learn applications of satellite image processing.
3. To extract the relevant information from on sheet and off sheet document.
4. To develop the software to understand the hand written document.
5. To understand the medical imaging in terms of anatomy of organ, sensing and futuristic decision.

AC 582 STATISTICAL METHODS

Introduction to Statistics, Meaning of Statistics as a Science, Importance of Statistics. Scope of Statistics, Introduction toData Analysis, Correlation and Regression, Concept of probability and probability distribution, Sampling distributions, Statistical Inference – Estimation, Statistical Inference – Tests of Hypothesis, Statistical Inference – Non Parametric methods, Time series analysis.

References :

1. Salil Kumar Chaudhari ,AshisK.Chakraborty: Statistical Methods, Asian Books private limited.
2. Dawn Griffiths: Modern Head First Statistics, O Reilly Publication

Course Outcome:

1. Learn to apply discrete and continuous probability distributions to various engineering problems.
2. Learn to compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting.
3. Be able to perform a multiple regression using computer software
4. Be able to conduct hypotheses tests for a population parameter for single sample and two sample cases.

AC 583 BIG DATA ANALYTICS

Overview of Big Data: Introduction, history, elements, related knowledge, big Data in Businesses, and types of big data analytics.

Technologies for Handling Big Data: Understanding Hadoop Ecosystem: HDFS, Map Reduce YARN, HBase, Hive, Pig, Sqoop, Zookeeper, Flume, Oozie etc. Understanding of Apache Spark: Programming in Scala, Spark Core, Interactive Data Analysis with Spark Shell, Writing a Spark Application, Spark Streaming, Spark SQL, Machine Learning with Spark Graph Processing with Spark. Understanding of Apache storm: Introduction to Apache Storm, Use Cases of Apache Storm, Key features and Architecture of a Storm cluster, Storm Programming.

Big Data Privacy and Ethics: Big data privacy, Risk in big data, Big data ethics, Transparency and Identity.

References

1. Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and GraphBy David Loshin
2. Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data: Analytics for Enterprise Class Hadoop and Streaming Data by Paul Zikopoulos, Chris Eaton.
3. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, By Michael Minelli, Michele Chambers, Ambiga Dhira.
4. Hadoop: The Defiantive Guide, By Tom White O'Rielly Publications 4th edition 2015.
5. High Performance Spark, By Holden Karau, Rachel Warren O'Rielly Publications 2014.
6. Getting Started with Storm, By Jonathan Leibiusky, Gabriel Eisbruch, Dario Simonassi O'Rielly Publications 2014.

Course Outcomes

1. This Course provides an insight to big data processing requirement and processing mechanism.
3. It provides a scalable and speedy solution to handle huge data processing.
4. It helps to analyse new business opportunities and next generation computations.
5. It helps to give the knowledge about big data batch processing using apache hadoop tool.
6. It helps to give the knowledge about real time, interactive and iterative big data processing using apache spark tool.
7. It helps to give knowledge about streaming data processing using apache storm.
8. This course note that the gains in performance of NoSQL versus RDBMS's due to differences in how the data is persisted and managed in memory and on disk.

AC 584 TECHNICAL FOUNDATION FOR e-COMMERCE

Introduction: Electronic commerce, technology and prospects, forces behind e-commerce, advantages and disadvantages, architectural framework, e-commerce strategy, e-commerce emerging issues and implementation issues, e-commerce law, government policies and agenda. E-Commerce Infrastructure: Internet and Intranet based e-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile information device, mobile computing applications, security issues in m-commerce. Electronic Payment System: Overview, electronic payment mechanisms and protocols, SET protocol, payment gateway, certificate, digital tokens, smart card, credit card, magnetic strip card, electronic money, electronic contracts, micro-payments, e-checks, e-cash Credit/Debit card based EPS, e-commerce payments security, online banking. electronic data interchange and its applications. Internet Advertising. Models of Internet advertising, sponsoring contents, corporate website, weaknesses in Internet advertising, web auctions and trading mechanism. Securing Business on Network. Security policies, procedures and practices, site security, firewalls, securing web service, transaction security, cryptology, cryptological algorithms, public key algorithms, authentication protocols, digital Signatures, virtual private network, security protocols for web commerce. Advanced Topics. Electronic commerce optimization algorithms, decision support systems for e-commerce, data mining for e-commerce, intelligent techniques for e-commerce.

References

1. E- Commerce Strategies, Technology and applications (David) Tata McGrawHill
2. E-Business Organizational and technical foundation (Michael P) Wiley Publication
3. John Benamati ,William S.Davis, E-Commerce Basics Technology Foundations and E-Business Applications, Prentice Hall

Course Outcome

At the end of the course,

1. The students are expected to realize the problems involved in designing and building e-commerce systems.
2. Understand the need to design EC systems that fully meet the requirements of the intended users.
3. Appreciate the need to ensure that the implementation of a design is adequately tested to ensure that the completed EC system meets the specifications.
4. Be fully aware of the principles and practice of an O-O approach to the design and development of EC systems; be able to apply these principles in practice

AC 585 INTEGER PROGRAMMING

Introduction; Model Building and Enhancements; Relaxation and Bounds, Introduction to Computational Complexity, Branch-and-Bound Frameworks, Branch and cut, and Dantzig- Wolfe decomposition. Strong Valid Inequalities; Lifting Procedures, Decomposition/Partitioning; Column Generation; Lagrangian Relaxation, 9 Implicit Enumeration, Advanced modeling; Reformulation-Linearization Technique. Fundamentals of integer Programming, complexity, computation, and polyhedral theory

References

1. M. Conforti, G. Corneujols, and G. Zambelli, Integer Programming, Spinger (2015).
2. Nemhauser, G.L. and Wolsey, L.A., Integer and Combinatorial Optimization John Wiley & Sons, 1999.

Course Outcome

The goals of this course are for students to:

1. Understand how integer variables are used for formulating complex mathematical models.
2. Be able to assess the difficulty of integer programming problems using the tools of complexity theory.
3. Understand and be able to use common methodology for the solution of integer programs.
4. Understand the basic concepts of polyhedral theory and how they apply to integer programming.
5. Understand the theory of valid inequalities and how it applies to the solution of integer programs.