Course Structure & Syllabus
of
M.Tech Programme
in
COMPUTER SCIENCE AND ENGINEERING

VSSUT, BURLA
VISION

To emerge as an internationally acclaimed Technical University to impart futuristic technical education and creation of vibrant research enterprise to create quality engineers and researchers, truly world class leader and unleashes technological innovations to serve the global society and improve the quality of life.

MISSION

The Veer Surendra Sai University of Technology, Odisha, Burla strives to create values and ethics in its products by inculcating depth and intensity in its education standards and need based research through

- Participative learning in a cross-cultural environment that promotes the learning beyond the class room.
- Collaborative partnership with industries and academia within and outside the country in learning and research.
- Encouraging innovative research and consultancy through the active participation and involvement of all faculty members.
- Facilitating technology transfer, innovation and economic development to flow as natural results of research where ever appropriate.
- Expanding curricula to cater broader perspectives.
- Creation of service opportunities for upliftment of the society at large.
DEPARTMENT OF CSE & IT

VISION

To be a recognized leader by imparting quality technical education and thereby facilitating the extensive research environment, equipping students with latest skills in the field of technology supplemented with practical orientation to face challenges in the fast morphing modern computing industry and academia for the betterment of the society.

MISSION

a. To produce best quality computer science / IT professionals and researchers by providing state-of-the-art training, hands on experience and healthy research environment.

b. To collaborate with industry and academia around the globe for achieving quality technical education and excellence in research through active participation of all the stakeholders.

c. To promote academic growth by establishing Center of Excellences and offering inter-disciplinary postgraduate and doctoral programs.

d. To establish and maintain an effective operational environment and deliver quality, prompt cost effective and reliable technology services to the society as well as compliment the local and global economic goals.

GRADUATE ATTRIBUTES:

The Graduate Attributes of NBA for PG Programme are:

- Engineering Knowledge
- Problem Analysis
- Design/Development of solutions
- Conduct investigations of complex problems
- Modern tool usage
# M.TECH IN COMPUTER SCIENCE AND ENGINEERING

## PROGRAM EDUCATIONAL OBJECTIVES

<table>
<thead>
<tr>
<th>PEO-1</th>
<th>The graduates will be able to employ their expertise in engineering to resolve various industrial and technological problems.</th>
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<tbody>
<tr>
<td>PEO-2</td>
<td>The graduates will be able to build up an ability to analyze the requirements, understand the technical specification, design and provide novel engineering solutions and produce efficient product design.</td>
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<tr>
<td>PEO-3</td>
<td>The graduates will be able to reveal professionalism, ethical attitude, and strong communication skills and maintain good teamwork spirit in their profession.</td>
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<td>PEO-4</td>
<td>The graduates will be able to interact with their peers in industry and society as engineering professionals and leaders to set up technical ambience in the society.</td>
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<td>PEO-5</td>
<td>The graduates will be able to employ their skill with a strong base to prepare them for higher learning and research activities.</td>
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<tr>
<td>PEO-6</td>
<td>The graduates will be emerged as leaders in engineering, management, applied research, and education.</td>
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</table>
PROGRAM OUTCOMES: At the end of the program the student will be able to:

1. Required expertise and knowledge of advanced computing and applications of engineering.
2. Necessary skill set to design and conduct scientific experiments as well as to analyze and interpret numerous data sets.
3. An ability to function or lead multi-disciplinary team, work cohesively and produce results.
4. An understanding of lifelong learning, professional development, social and ethical responsibility.
5. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
6. Graduates are able to participate and succeed in various competitive examinations for research and development.
7. An interest to investigate complex problems, deriving joy from learning and discovering new things.

Mapping of program outcomes with program educational objectives:

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<thead>
<tr>
<th>PEOs</th>
<th>Program Outcomes</th>
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<td>1</td>
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# M.TECH IN COMPUTER SCIENCE AND ENGINEERING

**Specialization: Computer Science & Engineering**

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<tr>
<th>1st Semester</th>
<th>2nd Semester</th>
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<tbody>
<tr>
<td><strong>Theory</strong></td>
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<td>Subject Code</td>
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<tr>
<td>Advances in Data Structures and Algorithms</td>
<td>Distributed Operating Systems</td>
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<tr>
<td>Advances in Computer Architecture</td>
<td>Advances in Database Systems</td>
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<tr>
<td>Design of Computer Networks</td>
<td>Cloud Technology</td>
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<tr>
<td>Elective-I &amp; II</td>
<td>Elective-III &amp; IV</td>
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<tr>
<td>Real Time Systems</td>
<td>Embedded Systems</td>
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<tr>
<td>Cryptography Foundation</td>
<td>Computational Intelligence.</td>
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<tr>
<td>Data Mining</td>
<td>Bio-Informatics.</td>
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<td>Wireless Sensor Networks</td>
<td>Social Network Analysis</td>
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<td>Intrusion Detection Systems</td>
<td>CAD VLSI</td>
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<tr>
<td>Object Oriented Analysis &amp; Design</td>
<td>Computational Complexity</td>
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<td>Robotics</td>
<td>Performance Evaluation of Computer Systems</td>
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<tr>
<td>Foundations of Computation</td>
<td>Parallel Systems</td>
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<tr>
<td><strong>Practicals / Sessionals</strong></td>
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<tr>
<td>Computational Laboratory – I</td>
<td>Computational Laboratory – III</td>
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<td>Computational Laboratory – II</td>
<td>Computational Laboratory – IV</td>
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<tr>
<td>Technical Writing &amp;Seminar – I</td>
<td>Technical Writing &amp;Seminar – II</td>
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<td>Comprehensive Viva Voce – I</td>
<td>Comprehensive Viva Voce – II</td>
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<th>3rd Semester</th>
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<tr>
<td>MIT-233</td>
<td>Comprehensive Viva Voce</td>
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<td>MIT-223</td>
<td>Seminar on Dissertation</td>
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<td><strong>Total</strong></td>
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Grand Total = 96
**DETAIL SYLLABUS**

**ADVANCES IN DATA STRUCTURES AND ALGORITHMS**

**Course Objective:**
- To understand, analyze and apply the concepts of Data Structures and Algorithms to solve computational problems.
- To analyze and compare the performance of various algorithms using different data structures in various applications.
- To introduce innovative and advanced concepts while understanding different data structures.
- To introduce some recent emerging algorithmic techniques for pursuing research on challenging computational problems.

**Elementary Data Structures & Complexity Analysis (10 Lectures)**
- Arrays, linked lists, trees, Asymptotic notations -big oh, omega and theta notations, Recurrence equations – solving recurrence equations, amortized analysis, NP completeness – NP-hard,
- Search, Heap and Multimedia Data Structures(14 Lectures)
  - AVL trees, 2-3 trees, 2-3-4 trees, Red-black trees, B-trees, Splay trees – Tries, Min-max heaps, Deaps, Leftist heaps, Binomial heaps, Fibonacci heaps, Skew heaps, Segment trees, k-d trees, Quad trees, R-trees.
- Applications (8 Lectures)
  - Set representation, Set union and find operations, Counting binary trees Huffman coding, Topological sort, Garbage Collection and Compaction, Min cut -max flow algorithm, Activity networks.
- Advanced Algorithms(8 Lectures)
  - Approximation Algorithms : Basic Concepts, Bounds, Polynomial Time Approximation Schemes, Hardness of Approximations, Case Study - Vertex Cover Problem

**Course outcome:**
1. Implement min-max heaps, binomial heaps, AVL trees and R trees.
2. Estimate time and space complexity of an algorithm.
3. Learn NP hard and NP complete problems and their solutions.

**Books :**
ADVANCES IN COMPUTER ARCHITECTURE

Course objective:
The objective of this course is to analyze the parallelism, identify the conditions of parallelism, and study different parallel interconnection systems. It also focuses on identifying the pipeline hazards, gain in-depth knowledge of architecture and learn parallel processing and its applications to solve workloads.

UNIT-1

UNIT-2
Pipelining: Linear pipe line processor, Asynchronous and Synchronous models, speed up, Efficiency, Throughput, Pipelining in MIPS architecture, Non linear pipe line processor, Instruction pipeline, Arithmetic pipeline. Conditions of Parallelism: Data and Resource Dependencies, Control Dependence, Resource dependence, Bernstein’s condition, Hardware and software parallelism, pipeline hazards and their Resolution Mechanisms like data forwarding, Delayed Branch, Branch Prediction, Dynamic Branch Prediction(Two state machine, four state machine), loop unrolling, dynamic scheduling, Software pipelining.

UNIT-3
Loosely coupled and tightly coupled system, Parallel Interconnection Systems: Static and Dynamic Networks, Linear Array, Ring, Star, Tree, Mesh, Systolic Array, Chordal ring, Completely connected network, Cube connected cycles, Torus, K-ary-n cube, Barrel shifter, single stage interconnection network, Multistage Interconnection Networks, Control Structure, Node degree, diameter, Bisection width, symmetric, functionality, Network Latency, Bandwidth, Scalability, Data routing functions:- Permutation, Perfect shuffle exchange, Hypercube Routing function.

UNIT-4
Memory hierarchy, Cache Design Issues, Memory Interleaving, Introduction to multicores, grid and cluster, Case studies on some commercial processors like Pentium, Power PC etc.

Course outcome:
1. Analyze the parallelism.
2. Identify the conditions of parallelism.
3. Study different parallel interconnection systems.
4. Identify the pipeline hazards.
5. Gain in-depth knowledge of architecture.
6. Learn parallel processing and its applications to solve workloads.
7. Understanding pipelined and non-pipelined processing.
Text Books:
2. Computer Architecture – A quantitative approach By J.L Hennessy and D.A.Patterson, Morgan Kaufmann

Reference Books:

DESIGN OF COMPUTER NETWORKS

Course Objective:
The objective of this course will help the students in:
1. Build an understanding of the concepts of computer networking with design, implementation and performance issues.
2. Promoting a comprehensive knowledge in different types of computer networks and multiservice networks.
3. Provide understanding and designing of different communication and transport protocols.
4. Develop computer network applications understanding the importance of social, business, technical, environmental and human context in which the applications would work.
5. Allow the student to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.
6. Articulate basic concepts, designing fundamentals of a network systems, and research findings to train professionals or to educate engineering students.
7. Contribute effectively as a team member/leader, using common tools and environment, in computer networking projects, research and education.
8. Pursue life-long learning and research in computer networks and contribute to the growth of that field and society at large.

Module -I
Introduction: Designing of a Computer networks, classifications of computer networks, layered network structures, Network performance (BW, delay x BW, RTT), Data Link Layers: Services and design issues, framing techniques(PPP, HDLC, SONET), error handling (One and Two Dimensional Parity Checks, CRC, Hamming code, Framing: Bit and Character Stuffing) and flow control, stop and wait, sliding window.

Module -II
LANs and their Interconnection: Basic concepts, Ethernet802.3, Ring 802.5,FDDI,RPR, Bluetooth, WI-Fi, WIMAX; Repeaters and Bridges.
ATM: ATM switches and AAL layer protocols.
Network Layer: Design issues, routing (IP protocol, Internet control protocols— ICMP, ARP and RARP, Internet routing protocols— RIP, OSPF, BGP, DVMRP, PIM and CIDR.).

Module -III
Network Structure: Concepts of subnets, global internet, backbone and local access; Channel sharing, techniques-FDM, TDM; congestion control techniques (General principles. Congestion
Prevention Policies, Traffic Shaping, Leaky-Bucket Algorithm, Token Bucket Algorithm),TCP, UDP

Module - IV

Application Layer: Name Services(DNS), Electronic mails(SMTP, MIME, IMAP), HTTP, Multimedia applications(SIP,H.323) PGP, SSH(Secure Shell), Transport layer security, IP security, Wireless security

Course Outcome:

1. Have a good understanding on underlying principle of the layering architecture in computer network.
2. Differentiate between different LAN-based forwarding devices so that they can make suggestions on how to build a network.
3. Apply knowledge of the TCP/IP layering model to intelligently debug networking problems.
4. To identify and discuss the concepts of underlying IP protocol and their main characteristics and functionality.
5. Write networking code that uses TCP and UDP in client-server applications.
6. Able to discuss relevant management issues and devise adequate network management solutions.

Text Books:


References:


REAL TIME SYSTEMS

Course objectives

1. To acquire the knowledge on various real-time system applications
2. To develop the ability to analyze real-time scheduling algorithms
3. To acquire the knowledge on real-time communication and data base

Module - I

Introduction: What is real time, Applications of Real-Time systems, A basic model of Real-time system, Characteristics of Real-time system, Safety and Reliability, Types of Real-time tasks, timing constraints, Modeling timing constraints  Real-Time Task Scheduling: Some important
concepts, Types of Real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA). Some issues Associated with RMA.

**Module - II**

**Module - III**

**Module - IV**
Real-time Communication: Examples of applications requiring real-time communication, Basic concepts, Real-time communication in a LAN. Soft Real-time communication in a LAN. Hard real-time communication in a LAN. Bounded access protocols for LANs. Performance comparison, Real-time communication over packet switched networks. Qos framework, Routing, Resource reservation, Rate control, Qos models.

**Course Outcomes:**
1. To understand the concepts on real-time system, communication and data base.
2. Study various real-time operating systems available for commercial purpose
3. To develop various real-time task scheduling algorithms.
4. Design of Extended finite state model for various real-time systems
5. To implement various real-time system techniques.

**Text Books:**

**Reference Books:**
CRYPTOGRAPHIC FOUNDATION

Course Objectives:

1. Build a solid mathematical basis to understand foundations of cryptography
2. Formally understand the notions related to security authentication and privacy.
4. Understand security threats, and the security services and mechanisms to counter them
5. Comprehend and apply relevant cryptographic techniques
6. Comprehend security services and mechanisms in the network protocol stack
7. Comprehend and apply authentication services and mechanisms

Module-I

Module-II

Module-III

Module-IV

Course Outcomes:

1. Should be able to apply knowledge of computing and mathematics for developing efficient security algorithms.
2. Should be able to identify security threats and determine efforts to counter them
3. Should be able to write code for relevant cryptographic algorithms.
4. Should be able to determine firewall requirements, and configure a firewall.
5. Should able to evaluate cryptographic primitives and their implementations for correctness, efficiency, and security.

Text Book:

References:

1. R. E. Smith, Internet Cryptography, AWL.
3. J. Hershey, Cryptography Demystified, McGraw Hill.
4. J. Knudsen, Java Cryptography, O’Reilly.

DATA MINING

Course Objectives:

The objective of this course is to provide students with an understanding of basic concepts in the Data Mining, and analysis form the basis for the emerging field of data science, which includes automated methods to analyze patterns and models for all kinds of data, with applications ranging from scientific discovery to business intelligence and analytics. Also, to provide a broad yet in-depth overview of data mining, integrating related concepts from machine learning and statistics.

Module – I
Data Mining overview: Data Warehouse and OLAP Technology, Data Warehouse Architecture, Steps for the Design and Construction of Data Warehouses, A Three-Tier Data Warehouse Architecture, OLAP, OLAP Queries, Metadata Repository, Data Preprocessing – Data Integration and Transformation, Data Reduction, Data Mining Primitives, System Architectures – Data Mining Primitives: What Defines a Data Mining Task? Task-Relevant Data, The Kind of Knowledge to be Mined, KDD.

Module – II
Mining Association Rules in Large Databases, Association Rule Mining, Market Basket Analysis: Association Rule Mining, Basic Concepts, Association Rule Mining A Road Map, Mining Association Rules from Frequent Itemsets, Mining Multilevel Association Rules from Transaction Databases, Multilevel Association Rules, Approaches to Mining Multilevel Association Rules, Mining Distance-Based Association Rules, From Association Mining to Correlation Analysis.

Module – III
Classification and Prediction – What is Classification? What is Prediction? Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Bayes Theorem, Classification by Backpropagation, A Multilayer Feed-Forward Neural Network, MLP, RBFN, Defining a Network Topology, Classification Based of Concepts from Association Rule Mining, Other Classification Methods, k-NearestNeighbor Classifiers, Genetic Algorithms, Fuzzy Set Approaches, Prediction, Linear and Multiple Regression, Nonlinear Regression, Other Regression Models, Classifier Accuracy.

Module – IV
Cluster Analysis – What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Classical Partitioning Methods: k-Means and k-Medoids, Partitioning Methods in Large Databases: k-Medoids, Hierarchical Methods,
Agglomerative and Divisive Hierarchical Clustering, Clustering Using Wavelet Transformation, Clustering High-Dimensional Space, Model-Based Clustering Methods, Statistical Approach, Neural Network Approach, LVQ, SOM, Mining Time-Series and Sequence Data, Mining Text Databases, Mining the World Wide Web. Applications and Trends in Data Mining – Data Mining Applications, Data Mining System Products.

Course Outcome

1. Understand the concepts of Data Mining
2. Classification by various techniques
3. Prediction and Classifier accuracy enhancement
4. Perform clustering by various methods
5. Understand the Applications and Trends in Data Mining

Text Book:

1. Data Mining: – Concepts and Techniques by Jiawei Han and Micheline Kamber, -- Morgan Kaufmann Publisher (Elsevier)

WIRELESS SENSOR NETWORKS

Course objectives

1. To understand the basic WSN technology and supporting protocols.
2. To understand MAC, network and transport layer protocols
3. Study about various security aspects of wireless sensor network.

Module – I

Module – II

Module – III

Module – IV
Course outcomes

1. Understand and demonstrate the principles of sensor design.
2. Understand various protocols for wireless sensor networks.
3. Apply the advance engineering principles for the critical analysis of sensor design
4. Select and apply appropriate principles for data collection and aggregation methods for problem solving.
5. Integrate engineering understanding and apply insight to solution of real problems.

Text Book


Reference Book


INTRUSION DETECTION SYSTEMS

Course Objectives

- To prepare students to know regarding the common threats faced today and the necessity of intrusion detection systems for securing the systems.
- To understand the essential concepts of intrusion and intrusion detection.
- Be familiar with principles and techniques used in intrusion detection and taxonomy of intrusion detection systems.
- Acquiring knowledge on the state of art of the research in intrusion detection systems.
- Enable students to do independent research and be able to model and implement intrusion detection systems.

Module – I
HOST-BASED INTRUSION DETECTION: Host Vulnerability and Exploits – Denial of Service (DoS), Gaining Unauthorized Access to Host, Case Study of Research in Host-Based Intrusion Detection Systems.

Module – II

Module – III
DATABASE AND APPLICATION-SPECIFIC INTRUSION DETECTION: Limitations of Existing Intrusion Detection Systems, Requirements of Application-Specific and Database Intrusion Detection, Case Study of Research in Application-Specific and Database IDS.

Module – IV

Course Outcomes
1. A comprehensive knowledge on the subject of intrusion detection and intrusion detection systems.
2. Understanding of the state of the art of intrusion detection research.
3. An exposure to the principles and techniques used in intrusion detection, as well as the challenges and limitations of intrusion detection systems.
4. Preparation to become a independent researcher in intrusion detection.

Text Book:
This is a research oriented course and currently no existing textbook on intrusion detection is appropriate. The course is mainly based on recent papers on intrusion detection systems published in academic conferences and journals.

Reference Books:

OBJECT ORIENTED ANALYSIS AND DESIGN

Course Objectives:
1. To develop a background knowledge as well as core expertise in object oriented system.
2. To analyze and design problems using UML.
3. To deliver the importance of software design process.
4. To be able to explain and justify designs based on design principles and patterns.

Module I
Introduction to Object Technology – Complexity, The Object Model, Classes and Objects, Classification. OOAD Methods - Object Oriented Design by Booch, Rumbaugh's Object Modelling Technique, Coad/ Yourdon's Object Oriented Analysis, Shlaer/ Mellor's Object Oriented Structured Analysis (OOSA) / Object Oriented Design Language(OODLE), Object Oriented Software Engineering (OOSE) by Jacobson.

Module II
Object Modelling using UML- The Notation, Analyzing and Designing problems using UML Diagrams.

Module III

Module IV

Course Outcomes:
1. Understand the different facets of object oriented methodologies.
2. Gain an understanding of how design patterns facilitate software design.
4. Apply object-oriented methods for analysis and design of real world problems.
5. Apply the concepts of UML to design real world problems.

Text Books:

2. J.Rumbaugh and Michael R. Blaha, "Object Oriented Modeling and Design", PHI
3. E Gamma, R Helm, R Johnson and J Vlissides, “Design Patterns- Elements of Reusable Object Oriented Software”, Pearson.
Reference Books:

1. Satzinger, Jackson, Burd, “Object-Oriented Analysis & Design with the Unified Process”, Course Technology Inc.

ROBOTICS

Course objectives

1. To acquire the knowledge on advanced algebraic tools for the description of motion.
2. To develop the ability to analyze and design the motion of articulated system.
3. To develop an ability to use software tools for analysis and design of robotic system.

Module 1: Fundamental of Robotics

Fundamentals: Components, degrees of freedom, joints, reference frames, coordinating Frames, mapping and transformation: coordinating frames, Mapping between frames, Description of objects in space, Transformation of vectors, Inverting a homogeneous Transform, Fundamental Rotation Matrices.

Module 2: Direct Kinematics model

Direct Kinematic model: Mechanical Structure and notations, Description of links and joints, Kinematic modelling of the manipulator, Denavit-Hartenberg, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

Module 3: Inverse Kinematics model and Dynamic Modeling

Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, lagrangian Mechanics, lagrange-Euler Formation, Newton-Euler Formation.

Module 4: Application of robotics in path planning problem

Motion planning, Trajectory path planning, soft-computing techniques for path planning: Fuzzy logic based path planning, Neural Network based path planning, GA based path planning, Particle swarm optimisation based path planning.

Course outcomes

1. Importance of automation and brief history of robot and application
2. Familiar with the kinematic motion of robot
3. Good knowledge of Robot configuration and subsystems and their design concepts.
4. Equipped with various sensors and their application in robots
5. Principles of robot programming and handle with typical robot
6. Working of mobile robots

Text books:
Foundations of Computations

Course Objective:
This course presents some formal notations that are commonly used for the description of computation and of computing systems, for the specification of software and for mathematically rigorous arguments about program properties. The following areas of study constitute the backbone of the course. Predicate calculus and natural deduction, inductive definitions of data types as a basis for recursive functions and structural induction, formal language theory (particularly regular expressions, finite state machines and context free grammars), and specification languages.

Module I
Logic and Proof: Propositional Logic, Boolean Algebra, Application: Logic Circuits, Predicates and Quantifiers, Deduction, Proof: Proof by Contradiction, Mathematical Induction, Application: Recursion and Induction, Recursive Definitions

Module II
Regular Expressions and FSA’s: Languages, Regular Expressions, Application: Using Regular Expressions, Finite-State Automata, NFA, Finite-State Automata and Regular Languages, Non-regular Languages
Grammars: Context-free Grammars, BNF, Parsing and Parse Trees, Pushdown Automata, Non-context-free Languages, General Grammars

Module III
Turing Machines and Computability: Turing Machines, Computability, The Limits of Computation

Module IV
Formal Modeling: Formal Modeling Methods, Formal Modeling Techniques, Varieties of formal analysis, Formal Conceptual Modelling, SCR basics, SCR Tables, Example: Temp Control System, Using Formal Methods, Case studies on recent topics including Network security, computer architecture etc.

Course Outcome:
1. Apply the concepts of standard mathematical logic to produce proofs or refutations of well-formed propositions or arguments phrased in English or in a variety of formal notations (first order logic, discrete mathematics or Hoare Logic).
2. Given a description of a regular language, as a regular expression or as a grammar, generate a finite state automaton that recognizes that language. Similarly, given a deterministic or nondeterministic automaton, give a description of the language which it accepts.

3. For an inductive definition of a simple data structure, write a recursive definition of a given simple operation on data of that type. Given some such recursively defined operations, prove simple properties of these functions using the appropriate structural induction principle.

4. Understand formal modelling techniques, network security and computer architecture.

5. Design a Turing Machine which will accomplish simple tasks

TextBooks:

3. Some research papers can be used for case studies.

DISTRIBUTED OPERATING SYSTEMS

Course Objective:
This course is designed to examine the fundamental principles of distributed systems, and provide students hands-on experience in developing distributed protocols. While we still look at issues in distributed operating systems, this course will address distributed systems in a broader sense.

UNIT-I [10Hrs]

UNIT-II [10Hrs]
Characterization of distributed systems, Design goals, Communication and computer networks, Distributed processing, Distributed operating systems, Client Server Communications.

UNIT-III [10Hrs]
Remote Procedure calls, File Service, Name Service, Distributed transactions and concurrency control, fault tolerance and security.

UNIT-IV [10Hrs]
Synchronization & Coordination, Distributed Algorithms, research issues. Special topics in distributed operating systems.

Course Outcome:
1. Examine the fundamental principles of distributed systems
2. Provide students hands-on experience in developing distributed protocols.
3. Understanding issues in distributed operating systems.

Text Books:

Reference Books:
5. P. S. Pacheco, Parallel Programming with MPI, Morgan Kaufmann.

ADVANCES IN DATABASE SYSTEMS

Course Objectives

1. To review the concepts of database architecture, schema and data models.
2. Revisiting the theory of normalization and various normal forms.
3. Develop proficiency in query processing and optimization.
4. To provide students with knowledge of database transaction processing, concurrency control and recovery from database failure.
5. To develop competence in students for designing and implementing a database for any real life application.
6. To expose students to advance topics and techniques those have promising research directions.

Unit 1: Review of Basic Database Concepts
Data Models, Schema and Instances, Three-Level Schema Architecture & Data Independence, E-R Modelling: Specialization, Generalization, Aggregation, Functional Dependencies, Decomposition, Concept of Normalization and Normal Forms

Unit 2: Query Processing and Optimization
Basic Steps in processing an SQL Query, Catalog Information for Cost Estimation, Measures of Query Cost, Selection and Join Operations, Query Optimization: Overview, Transformation of Relational Expressions by Equivalence Rules

Unit 3: Transaction Management and Concurrency Control
Transaction concept, Transaction state, Implementation of Atomicity and durability, Concurrent executions, Serializability, Concurrency Control Schemes: Lock-based, Timestamp based, Validation based protocol, Multiple granularity, Multiversion schemes, Deadlock handling, Recovery System

Unit 4: Advanced Topics
Course Outcomes

1. Compare and evaluate alternative database architectures and models in different application contexts.
2. Apply normalization steps in database design for minimizing redundancy and data anomalies.
3. Understanding of transaction management, concurrency control and how they affect database integrity and consistency.
4. Employ the conceptual and relational models to design large database systems.
5. Able to use recent and advanced database techniques for carrying out research.

Text Book:


References Books:


CLOUD TECHNOLOGY

Course objectives:
This course covers a series of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service. For different layers of the cloud technologies, practical solutions such as Google, Amazon, Microsoft, SalesForce.com, etc. solutions as well as theoretical solutions (covered by a set of papers) are introduced.

Module – I

Module – II

Module – III

Module – IV

Course Outcome:

1. Understanding of current cloud computing technologies, including technologies for Infrastructure as a Service, Platform as a Service, Software as a Service, and Physical Systems as a Service.
2. Learning different layers of the cloud technologies,
3. Finding practical solutions such as Google, Amazon, Microsoft, SalesForce.com, etc. solutions as well as theoretical solutions.

Text Book:


Reference Book:

EMBEDDED SYSTEMS

Course Objective

An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability.

UNIT-1
Introduction: Embedded system, Features of Embedded Systems, Design Metrics, Embedded System Design flow, Processor in the system, Other hardware units, Software embedded into a system, Exemplary embedded systems, Embedded System-on-chip (SOC) and in VLSI circuit. Devices and Device Drivers: Serial communication using the ‘I2C’, ‘CAN’ Parallel communication between the networked I/O multiple devices using the ISA, PCI, PCI-X Device drivers, Interrupt servicing (Handling) mechanism.
Processor selection for an embedded system, Memory selection for an embedded system, Inter process communication.

UNIT-2
Real Time Operating System: Types of Real-time tasks, Task Periodicity, Task Scheduling, Classification of Scheduling algorithms, Clock driven scheduling, Event driven scheduling, Features of RTOS, Commercial RTOS, Windows CE, LynxOS, VxWorks, Introduction to microc/OS-II
Case Studies of Programming with RTOS: Case study of an embedded system for a smart card.

UNIT-3
Hardware and Software Co-design: Embedded system project management, Embedded system design and co-design issues in system development process, Design cycle in the development phase for an embedded system

UNIT-4
Low power Embedded system Design: Sources of Power Dissipation, Dynamic power dissipation, Static power dissipation, Power reduction techniques, System level power management.

Course Outcome

- Knowledge and understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware
- A wide competence from different areas of technology, especially from computer engineering, embedded intelligent systems and mechatronics.
- Deep state-of-the-art theoretical knowledge in the areas of real time systems, embedded processors, sensor and measuring systems, and their interdisciplinary nature needed for integrated hardware/software co-design of embedded systems.
- Understanding and experience of state-of-the-practice industrial embedded systems and intelligent embedded system development.

Text Books:
1. Embedded Systems-Architecture, Programming and Design – Raj Kamal, TMH
2. Embedded system design – Santanu Chattopadhyay, PHI
References:

COMPUTATIONAL INTELLIGENCE

Course Objectives:
1. To understand, analyze and apply the concepts of neural network, neuro-modelling, several neural network paradigms.
2. To understand, analyze and apply the concepts of fuzzy logic, knowledge representation using fuzzy logic, approximation reasoning, fuzzy inference system, fuzzy logic control and other machine intelligent application of fuzzy logic.
3. To understand, analyze and apply the concept of evolutionary computing paradigm known as genetic algorithm to engineering optimization problems.
4. To understand, analyze and apply the concept of hybrid algorithms in different engineering application.

Module 1: Neural Network

Module 2: Fuzzy Logic

Module 3: Evolutionary Computing
Fundamentals of genetic algorithms: Encoding, Fitness functions, Reproduction Genetic Modeling: Cross cover, Inversion and deletion, Mutation operator, Bit-wise operators, Bitwise operators used in GA. Convergence of Genetic algorithm, GA as an alternative to back propagation, Applications of GA in navigational planning of robots, Particle swarm optimisation, ant-colony optimisation, Bee colony optimisation.

Module 4: Hybrid Systems

Course Outcomes
1. To known about the basic concept of computational intelligence and also their use in some real life situation.
2. To solve the problems using neural network techniques.
3. To find the solution using different fuzzy logic techniques.
4. To use genetic algorithms for different modeling.
5. To integrate the various evolutionary computing.

Text Books:

Reference Books:
2. Soft-computing, D.K.Pratihar,Alpha Science

BIOINFORMATICS

Course Objectives
Objective of this course to provide students with an understanding of the theory and practice of bioinformatics analysis of biological sequence data. Theory includes understanding principles and pitfalls in the biology and analysis of these data, and algorithms for alignment, assembly, annotation, and phylogenetic inference. Practice includes the use of pre-existing and novel tools, and application to a wide range of real-world uses of bioinformatics analysis.

Unit-I

Unit-II
Suffix Trees: Definitions and examples, Ukkonen’s linear-time suffix tree algorithm, Applications (exact string matching, longest common sub strings of two strings, Recognizing DNA

Unit-III
Pair-wise Sequence Alignment (Edit distance Dynamic Programming Calculation of edit distance, string similarity, gaps). Pair-wise sequence alignment (local), HMM for pair-wise alignment.

Unit-IV
Multiple String Alignment: Need of MSA, Family & Super family representation, multiple sequence comparison for structural inferences, multiple alignments with sum-of-pairs, consensus objective functions. Profile HMM for multiple sequence alignment. Database searching for similar sequence (FASTA, BLAST), PAM, BLOSOM, substitution matrices.

Unit-V
Phylogenetic Reconstruction: Phylogenetic Trees, Parsimony methods, Distance methods,
Evolutionary models, Hierarchical clustering method, Maximum Likelihood method, Model comparison, Fragment Assembly Problem.

Course Outcomes

On completion of the course students should be able to:

- Perform simple alignment, assembly, and annotation algorithms by hand for "toy" data sets.
- Formulate and justify appropriate choices in technology, strategy, and analysis for a range of projects involving DNA, RNA, or protein sequence data.
- Employ command line sequence analysis tools to analyze real-world biological sequence data sets, and demonstrate familiarity with the syntax and options required to generate meaningful interpretations.
- Survey methods involving the analysis of interactions between proteins, nucleic acids, and other molecules, and their applications to biomedical and other real-world problems.

TextBooks:

Reference Book:

1. M.S. Waterman – Introduction to Computational Biology – Chapman & Hall CRC.

SOCIAL NETWORK ANALYSIS

Course Objectives:

The objective of this course is to provide students with an understanding of basic concepts in Social Network Analysis and explain its importance. Social Network Analysis is the application of Facebook, Twitter and Linkedin and they typically contain a tremendous amount of content and linkage data which can be leveraged for analysis. The linkage data is essentially the graph structure of the social network and the communications between entities; whereas the content data contains the text, images and other multimedia data in the network. The basic object of social network analysis is to study and analyse the different network structure when the actors are interact to each other in a real world. The richness of this network provides unprecedented opportunities for data analytics in the context of social networks.
Module – I

Module – II

Module – III
Cascading properties of networks: Information/influence diffusion on networks, maximizing influence spread, power law and heavy tail distributions, preferential attachment models, small world phenomenon

Module – IV

Course Outcome:
1. Understand the concepts Social Network and its analysis.
2. Understand the community structure and cohesiveness of different sub groups.
3. Understand the cascading properties of different networks.
4. Analysis of decentralize online social networks.
5. Understand different link analysis for web mining.

Text Books:

References
CAD VLSI

Course Objectives:

1. Understand the concepts of Physical Design Automation
2. Analyze the algorithms on placement, partitioning, floor planning and Routing
3. Simulation and synthesis of logic circuits

Unit I VLSI Design Methodologies

UNIT II Design Rules
Layout Compaction, Design rules, problem formulation, algorithms for constraint graph compaction, placement and partitioning, Circuit representation, Placement algorithms, partitioning

UNIT III Floor Planning and Simulation
Floor planning concepts, shape functions and floorplan sizing, Types of local routing problems, Area routing, channel routing, global routing, algorithms for global routing. Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT IV Modeling And Synthesis
High level Synthesis, Hardware models, Internal representation, Allocation assignment and scheduling, Simple scheduling algorithm, Assignment problem, High level transformations.

Course Outcomes:

1. Study and understand the VLSI design methodologies and automation tools
2. Understand and analyze the steps of a physical design cycle
3. Simulation, Modeling and Synthesis of VLSI circuits

Text Books


COMPUTATIONAL COMPLEXITY

Course Objectives:

- To understand the limits of computation and hardness of a computational problem
- To understand and analyze the basic concepts of models of computation and complexity classes.
- To Introduce some advanced level research concepts based on various computation techniques and their complexity classes
UNIT – I
Introduction, Models of Computation, resources(time and space), algorithms, computability, complexity, Intractability.

UNIT-II
Complexity classes, P, NP, Proving NP-Completeness Results, Using NP-Completeness to analyze problems, reductions, NP-hardness, co-NP, P-SPACE, hierarchy, relationships between complexity classes.

UNIT-III
Randomized computation and complexity, Circuit complexity and lower bounds, Parallel computation and complexity, Communication complexity, Quantum computation.

UNIT-IV
Approximability, Logical characterizations, incompleteness, Counting problems, Interactive proofs, Probabilistically checkable proofs.

Course Outcomes
1. Classification of a computational problem into a complexity class based on its hardness.
2. Analyze a complexity of a computational problem based on a model
3. Apply the advanced research topics learnt to find the solution of hard problems

Text Books:

References:

PERFORMANCE EVALUATION OF COMPUTER SYSTEMS

Course Objectives:
- Understand the methods, techniques and metrics for performance evaluation of Computer systems.
- Understand the probability theory and statistical tools used in performance evaluation
- Analysis of Simulation techniques and experiment designs
- Analysis of Queuing theory and queueing networks

UNIT-I Overview of Performance Evaluation
Need for Performance Evaluation in Computer Systems, Overview of Performance Evaluation Methods, Techniques, metrics, and common mistakes, Workload Characterization & Techniques, Monitors, Program-Execution Monitors and Accounting Logs, Capacity Planning and Benchmarking, Data presentation techniques, Ratio games.

**UNIT-II Probability Theory and Statistical Tools**

**UNIT- III Simulation, Experimental Design and Analysis**
Experimental design and analysis : Full factorial designs, Full factorial designs with replications, Fractional factorial designs, One factor experiments, Histograms and density estimation

**UNIT-IV Queuing Theory**
Introduction, Analysis of a Single Queue, Queueing Networks, Operational Laws, Mean Value Analysis and Related Techniques, Convolution Algorithm, Markov Chains, Birth-Death Process, M/M/1 queues.

**Course Outcomes :**
2. Apply probability theory and statistical tools for system design and comparison of system performances.
3. Simulation of system performance and Analysis of simulation results

**Text Books:**

**PARALLEL SYSTEMS**

**Course Objective**
A practically oriented introduction to programming paradigms for parallel computers, Considers definitions of program efficiency on parallel computers, addresses the modelling, analysis and measurement of program performance. Description, implementation and use of parallel
programming, parallel features, parallel communication operations, library routines and applications.

UNIT-1 Introduction to Parallel Computing:

UNIT-2

UNIT-3
Basic Communication Operations: One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

UNIT-4

UNIT-5

Course Outcome

- Be proficient at programming multiple parallel machines in more than one special programming language or programming system
- Be able to descriptively compare the performance of different programs and methods on one machine
- Demonstrate advanced knowledge of the elements of parallel programming, parallel communication and system implementation
- Recall the history of parallel systems, principles of parallel algorithms and describe the developments in the field of parallel computing.

Text Books:
1. Introduction to parallel computing by Ananth Grama, Anshul Gupta, Gorge Karypis, Vipin Kumar, Pearson