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 tocreate 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 intensityin 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 studentswith latest skills in the field of technology supplemented with practical orientation to face challenges in the fast morphing modern computing industry andacademia 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 thesociety 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

PEO-1	The graduates will be able to employ their expertise in engineering to resolve various industrial and technological problems.
PEO-2	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.
PEO-3	The graduates will be able to reveal professionalism,ethical attitude, and strong communication skills and maintain good teamwork spirit in their profession.
PEO-4	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 thesociety.
PEO-5	The graduates will be able to employ their skill with a strong base to prepare them for higher learning and research activities.
PEO-6	The graduates will be emerged as leaders in engineering, management, applied research, and education.

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:

PEOs	Program Outcomes						
	1	2	3	4	5	6	7
The graduates will be able to employ their expertise in engineering to resolve various industrial and technological problems.		X					X
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.	X				X		X
The graduates will be able to reveal professionalism, ethical attitude, and strong communication skills and maintain good teamwork spirit in their profession.			X	X			
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.	X		X				X
The graduates will be able to employ their skill with a strong base to prepare them for higher learning and research activities.						X	
The graduates will be emerged as leaders in engineering, management, applied research, and education.	X	X					X

M.TECH IN COMPUTER SCIENCE AND ENGINEERING

Specialization: Computer Science & Engineering

1st Semester

Theory

Subject Code	Subject	L-T-P	Credit
	Advances in Data Structures and Algorithms	3-1-0	4
	Advances in Computer Architecture	3-1-0	4
	Design of Computer Networks	3-1-0	4
	Elective-I & II		
	Real Time Systems	3-1-0	4
	Cryptography Foundation	3-1-0	4
	Data Mining	3-1-0	4
	Wireless Sensor Networks	3-1-0	4
	Intrusion Detection Systems		
	Object Oriented Analysis & Design	3-1-0	4
	Robotics	3-1-0	4
	Foundations of Computation	3-1-0	4

Practicals / Sessionals

	Computational Laboratory – I	0-0-3	2
	Computational Laboratory – II	0-0-3	2
	Technical Writing &Seminar – I	0-0-3	2
	Comprehensive Viva Voce – I		2
Total			**28**

2nd Semester

Theory

Subject Code	Subject	L-T-P	Credit
	Distributed Operating Systems	3-1-0	4
	Advances in Database Systems	3-1-0	4
	Cloud Technology	3-1-0	4
	Elective-III & IV		
	Embedded Systems	3-1-0	4
	Computational Intelligence.	3-1-0	4
	Bio-Informatics.	3-1-0	4
	Social Network Analysis	3-1-0	4
	CAD VLSI		
	Computational Complexity	3-1-0	4
	Performance Evaluation of Computer Systems	3-1-0	4
	Parallel Systems	3-1-0	4

Practicals / Sessionals

	Computational Laboratory – III	0-0-3	2
	Computational Laboratory – IV	0-0-3	2
	Technical Writing &Seminar – II	0-0-3	2
	Comprehensive Viva Voce – II		2
Total			**28**

3rd Semester

Practicals / Sessionals

Subject Code	Subject	L-T-P	Credit
MIT-243	Dissertation Interim Evaluation		10
MIT-233	Comprehensive Viva Voce		3
MIT-223	Seminar on Dissertation		2
Total			**15**

4th Semester

Practicals / Sessionals

Subject Code	Subject	L-T-P	Credit
MIT-244	Dissertation Open Defense		5
MIT-245	Dissertation Evaluation		20
Total			**25**

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)
Online Algorithms : Basic Concepts, Optimization Problems, Competitive Analysis, Deterministic Algorithms, Randomized Algorithms, Optimum Offline Algorithms, Case Study - Ski Rental Problem.
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 :

1. Introduction to Algorithms, Thomas H.Corman, Charles E.Leiserson, Ronald L. Rivest, Second Edition, PHI 2003.
2. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education, 3rd Ed, 2007.
3. *Online Computation and Competitive Analysis* - A. Borodin and R. El-Yaniv, Cambridge Univ. Press, 1998.
4. *Approximation Algorithms* - Vijay V. Vazirani, Springer Verlag, 2003.

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

Flynn's classification: SISD, SIMD, MISD, MIMD, Parallel Processing: Definition, Theory of Parallelism. Parallel Computer Models, Parallelism in Uni-processor computers, Implicit Parallelism vs. explicit parallelism, Levels of parallelism. Soft ware Parallelism, Hardware Parallelism, Amdahl's law, Overview of RISC and CISC architecture, System Performance attributes of parallel Computers.

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:

1. Advanced Computer Architecture, by Kai Hwang Mc Graw Hill.
2. Computer Architecture – A quantitative approach By J.L Hennessy and D.A.Patterson, Morgan Kaufmann

Reference Books:

1. Introduction to Parallel Computing, 2nd Edition, Pearson Education by Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar.

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:

1. L. L. Peterson and B. S. Davie: Computer Network, Morgan Kaufman, San Mateo, 2009.
2. J. F. Kurose, K. W. Ross : Computer Networking: A Top-Down Approach, 6th Edition, Pearson, 2013

References:

1. Tannenbaum, Wetherall: Computer Networks, 5th ed., Pearson, 2010.
2. W. Stallings: Data and Computer Communications, Pearson, 2013.
3. Kaufman, R. Perlman and M. Speciner: Network Security, Pearson, 2002.
4. L. Gracial and I. Widjaja: Communication Networks, Tata-McGraw Hill, New Delhi, 2000.
5. Prakash C. Gupta: Data Communication and Computer Network, PHI Learning Pvt. Ltd. 2006

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

Handling Resource Sharing and dependencies among Real-time Tasks: Resource sharing among real-time tasks. Priority inversion. Priority Inheritance Protocol (PIP), Highest Locker Protocol (HLP). Priority Ceiling Protocol (PCP). Different types of priority inversions under PCP.Important features of PCP. Some issues in using a resource sharing protocol, Handling task dependencies. Scheduling Real-time tasks in multiprocessor and distributed systems: Multiprocessor task allocation, Dynamic allocation of tasks. Fault tolerant scheduling of tasks. Clock in distributed Real-time systems, Centralized clock synchronization.

Module - III

Commercial Real-time operating systems: Time services, Features of a Real-time operating system, Unix as a Real-time operating system, Unix-based Real-time operating systems, Windows as a Real-time operating system,POSIX, A survey of contemporary Real-time operating systems. Benchmarking real-time systems. Real-time Databases: Example applications of Real-time databases. Review of basic database concepts, Real-time databases, Characteristics of temporal data. Concurrency control in real-time databases. Commercial real-time databases.

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:

1. Real-time Systems Theory and Practice by Rajib Mall, Pearsons Publication.

Reference Books:

1. J.W.S.Liu, “Real-Time Systems”, Pearson Education, 2000
2. Alan Burns, Andy Wellings, “Real-Time Systems and Programming Languages 3/e”, Addison Wesley.
3. Raymond A.Buhr and Donald L.Baily, “Introduction to Real-Time Systems”, Prentice Hall.
4. Nissanke, “Real-Time System”, Prentice Hall.

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.
3. Understand security concepts, Ethics in Cryptography.
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

Introduction to Security: Definition, Goal and Challengaes, OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms, Techniques, Model for Network Security, Mathematics of Cryptography: Integer Arithmetic, Modular rithmatic, Matrices, Linear Congruence, Algebraic Structures: Group, Ring, Field, Galois Field, Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Stream and Block Cipher, Steganography.

Module-II

Modern Symmetric Key Ciphers: Modern Block Ciphers, Modern Stream Ciphers, Data Encryption Standard (DES): DES Structure, DES Analysis, Multiple DES, Security of DES, Advanced Encryption Standard (AES), AES Transformation functions, Analysis of AES, Use of Modern Block Ciphers: ECB, CBC, CFB, OFB, CTR, Use of Stream Ciphers: RC4, Key Management, Key Generation.

Module-III

Number Theory: Prime Numbers, Fermat's and Euler's Theorems, Testing of Primality, Shinese Remainder Theorem, Exponentiation and Logarithm, RSA Algorithm, Elgamal Cryptosystem, Elliptic Curve Cryptography, Diffe-Hellman Key Exchange.

Module-IV

Message Integrity and Message authentication: Application of Cryptographic Hash Functions, Two Simple Hash functions, Requirements and security, Secure Hash Algorithm (SHA), Message Authentication Requirements, Message authentication functions, Message Authentication Codes (MAC), Security of MAC, Digital Signature, Digital Signature Standards.

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:

1. B. A. Forouzan, *Cryptography & Network Security*, McGraw Hill, Special Indian Edition, 2007.

2. W. Stallings, *Cryptography and Network Security*, Pearson Education, 3rd Ed, 2006.

References:

1. R. E. Smith, Internet Cryptography, AWL.
2. A. J. Menezes, Handbook of Applied Cryptography, CRC Press.
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 basisfor the emerging field of data science, which includes automated methodsto analyze patterns and models for all kinds of data, with applicationsranging from scientific discovery to business intelligence and analytics. Also, to provide a broad yet in-depth overview of data mining, integrating relatedconcepts from machine learning and statistics.

Module – I

Data Mining overview : Data Warehouse and OLAP Technology Data Warehouse Architecture, Steps for theDesign 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: AssociationRule Mining, Basic Concepts, Association Rule Mining A Road Map, Mining Association Rules from FrequentItemsets, Mining Multilevel Association Rules from Transaction Databases, Multilevel Association Rules,Approaches to Mining Multilevel Association Rules, Mining Distance-Based Association Rules, FromAssociation Mining to Correlation Analysis.

Module – III

Classification and Prediction – What is Classification? What Is Prediction? Issues Regarding Classification andPrediction, Classification by Decision Tree Induction, Bayesian Classification, Bayes Theorem, Classification byBack propagation, 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 MajorClustering Methods, Classical Partitioning Methods: k-Means and k-Medoids, Partitioning Methods in LargeDatabases: k-Medoids, Hierarchical Methods,

Agglomerative and Divisive Hierarchical Clustering, ClusteringUsing Wavelet Transformation, Clustering High-Dimensional Space, Model-Based Clustering Methods,Statistical Approach, Neural Network Approach, LVQ, SOM,Mining Time-Series and Sequence Data, MiningText Databases, Mining the World Wide Web. Applications and Trends in Data Mining – Data MiningApplications, 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 MichelineKamber, -- Morgan Kaufmann Publisher (Elsevier)
2. Data Mining Concepts, Models, Methods and Algorithms By MehmedKantardzicWiley Interscience, IEEE Press.

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

Ad Hoc Wireless Networks: Issues in Ad Hoc Wireless Networks, Ad Hoc Wireless Internet, MAC Protocols for AdHoc Wireless Networks: Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols.

Module – II

Routing Protocols for Ad Hoc Wireless Networks: Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Power-Aware Routing Protocols.

Module – III

Multi-cast routing in Ad Hoc Wireless Networks: Issues in Designing a Multicast Routing Protocol, Classifications of Multicast Routing Protocols, Energy-Efficient Multicasting, Multicasting with Quality of Service Guarantees, Application-Dependent Multicast Routing.

Module – IV

Security Protocols for Ad Hoc Wireless Networks: Security in Ad Hoc Wireless Networks. Network Security Requirements. Issues and Challenges in Security Provisioning. Network Security Attacks. Key Management. Secure Routing in Ad Hoc Wireless Networks; Energy Management in Ad Hoc Wireless Networks: Classification of Energy Management Schemes, Transmission Power Management Schemes, System Power Management Schemes.

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

1. C. S. Ram Murthy, B. S. Manoj, Ad Hoc Wireless Networks: Architectures and Protocols, Prentice Hall of India, 2nd Ed. 2005.
2. RaminHekmat, Ad-hoc Networks: Fundamental Properties and Network Topologies, Springer, 1st Ed. 2006.

Reference Book

1. B. Tavli and W. Heinzelman, Mobile Ad Hoc Networks: Energy-Efficient Real-Time Data Communications, Springer, 1st Ed. 2006.
2. G. Anastasi, E. Ancillotti, R. Bernasconi, and E. S. Biagioni, Multi-Hop Ad Hoc Newtorks from Theory to Reality, Nova Science Publishers, 2008

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

INTRODUCTION: Basic Concepts of Security, Introduction to Intrusions, Need of Intrusion Detection, Taxonomy of Intrusion Detection Systems (IDSs), Theoretical Background of Intrusion Detection, Case Study of Representative Intrusion Detection Systems.

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

NETWORK-BASED INTRUSION DETECTION: Network Vulnerabilities and Attacks – ARP Attacks, IP Attacks, ICMP Attacks, UDP Attacks, TCP Attacks, DNS Attacks, Case Study of Research in Network-Based Intrusion Detection Systems.

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.

MISUSE DETECTION: Principles of Misuse Detection, Advantages & Limitations of Misuse Detection, Misuse Detection Techniques, Case Study of Research in Misuse Detection Systems.

Module – IV

ANOMALY DETECTION: Principles of Anomaly Detection, Advantages & Limitations of Anomaly Detection, Anomaly Detection Techniques, Case Study in Research in Anomaly Detection Systems

HYBRID INTRUSION DETECTION: Principle of Hybrid Intrusion Detection, Advantages of Hybrid Model, Case Study of Research in Hybrid Intrusion Detection Systems.

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 asthe 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:

1. Matt Bishop, "Computer Security: Art and Science", Addison-Wesley Professional, 2003.
2. R. D. Pietro & L. V. Mancini, "Intrusion Detection Systems", Handbook of Advances in Information Security, Springer, 2008.
3. Carl Endorf, Eugene Schultz and Jim Mellander, "Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
4. Stephen Northcutt, Judy Novak, "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002.

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

Process - Principles, The Macro Process, The Micro Process. Object Oriented Testing – Testing Object Oriented Systems, Challenges in Object Oriented Testing, Testing Approaches, Integration Testing of Object Oriented Programs. Software Quality Assurance & Metrics - Software Quality, Quality Assurance, Quality Factors, Object Oriented Metrics. Benefits & Risks of Object Oriented Development.

Module IV

Design Patterns- Introduction, Overview of Common Design Patterns, Creational Design Patterns, Structural Design Patterns, Behavioral Design Patterns.

Applications of OOAD- CASE STUDIES- Satellite Based Navigation, Traffic Management, Cryptanalysis, Weather Monitoring Station, Vacation Tracking System.

Course Outcomes:

1. Understand the different facets of object oriented methodologies.
2. Gain an understanding of how design patterns facilitate software design.
3. Understand Object Oriented Software Development Process.
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:

1. Grady Booch, "Object-Oriented Analysis & Design with Applications", 3rd Edition, Pearson.
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.

2. Craig Larman. "Applying UML and Patterns – An Introduction to Object-Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education.

3. Jim Arlow, Ila Neustadt, "UML 2 and the Unified Process – Practical Object Oriented Analysis and Design", Pearson Education.

4. Timothy C. Lethbridge, Robert Laganiere, "Object Oriented Software Engineering", Tata McGrawHill.

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:

1. Fu, Gonzales and Lee, Robotics, McGraw Hill
2. Robotics and Control Mittal and Nagrath Tata McGraw-Hill Education
3. Artificial Intelligence and Soft Computing: Behavioral and Cognitive Modeling of the Human Brain, Amit Konar, CRC Press

Reference Book:

1. Robert Shilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India

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

Sets, Functions, and Relations: Basic Concepts, The Boolean Algebra of Sets, Application: Programming with Sets, Functions, Application: Programming with Functions, Counting Past Infinity, Relations, Application: Relational Databases

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:

1. Carol Critchlow, David Eck, "Foundations Of Computation", Second Edition (Version 2.3.1, Summer 2011)
2. Rajesh Gupta, Paul Le Guernic, Sandeep Kumar Shukla, Jean-Pierre Talpin, "Formal Methods and Models for System Design: A System Level Perspective", Kluwer Academic Publisher, 2004
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]
Introduction to parallel Computing, Solving problems in parallel, Structures of parallel computers, Instruction level parallel processing, Parallel Algorithms, Parallel programming, Operating Systems for parallel computers, Performance Evaluation of parallel computers.
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:

1. G. Coulororis, J. Dollimore & T. Kindberg, Distributed Systems: Concepts and Design, Addison-Wesley.
2. M. Singhal & N. G. Shivaratri, Advanced Concepts in Operating Systems, McGraw Hill.

Reference Books:

1. P. K. Sinha, Distributed Operating Systems, IEEE Press.
2. H. F. Jordan, Fundamentals of Parallel Processing, Pearson.
3. C. Hughes & T, Hughes, Parallel and Distributed Programming Using C++, Pearson.
4. W. Buchanan, Distributed Systems and Networks, Tata McGraw Hill.
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

Data Mining, Data Warehousing, Parallel Databases, Distributed Databases, Mobile Databases, Multimedia Databases, Spatial database, Temporal databases.

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:

1. Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systems, 6th Edition, Pearson Education India.

References Books:

1. Silberschatz, Korth, and Sudarshan, "Database system Concepts, 4/e", Tata-Mc-Graw Hill.
2. Bipin C. Desai: Introduction to Data Base Systems, Galgotia Publications.
3. C. J Date, "Introduction to database Systems, 7/e", Pearson Education India.

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

Defining Cloud Computing, Types, The NIST Model, The Cloud Cube Model, Deployment Models, Service Models, Characteristics, Benefits, Disadvantages, Measuring the Cloud's Value, The Laws of Cloudonomics, Challenges and Obstacles, Behavioral Factors Relating to Cloud Adoption, Measuring Costs, Service Level Agreements, Licensing Models.

Module – II

Cloud Computing Stack, Composability, Virtual Appliances, Communication Protocols, Connecting to the Cloud, Cloud Computing Ecosystem, IaaS, PaaS and SaaS, IaaS Workloads, Pods, Aggregation and Failover in IaaS, Open SaaS and SOA, Salesforce.com and CRM SaaS, Identity as a Service, Compliance as a Service, Virtualization Technologies, Load Balancing and Virtualization, Advanced Load Balancing, The Google Cloud, Hypervisors, Virtual Machine Types, VMware, Machine Imaging, Virtual Machine Placement and Migration.

Module – III

Amazon Web Services, Components and Services, Elastic Compute Cloud, Amazon Machine Images, Pricing Models, Instances, Simple Storage System, Elastic Block Store, Content Delivery Network, Database Services, SimpleDB, Relational Database Service, Cloud Security, The Security Boundary, Securing Data, Brokered Cloud Storage Access, Storage Location and Tenancy, Auditing and Compliance, Identity Protocol Standards, Cloud APIs.

Module – IV

A Reference Model for Market-oriented Cloud Computing, Federated Clouds/Inter Cloud: Characterization, Federation Stack, Technologies for Cloud Federations, Cloud Applications: Healthcare, Protein Structure Prediction, Gene Expression Data Analysis for Cancer Diagnosis, Geoscience, Social Networking, Media Applications and Multiplayer Online Gaming.

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:

1. B. Sosinsky, Cloud Computing Bible, Wiley Publishing Inc., 2011.
2. R. Buyya, C. Vecchiola and S. Thamarai Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, Elsevier, 2013.

Reference Book:

1. B. Sosinsky, Cloud Computing Bible, Wiley, 2011.
2. D. N. Chorafas, Cloud Computing Strategies, CRC Press, Taylor and Francis Group, 2011.
3. P. K. Pattnaik, M. R. Kabat and S. Pal, Fundamentals of Cloud Computing, Vikas Publishing House Pvt. Ltd., 2015.

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, Embeded 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:

1. Hardware Software Co-design of Embedded Systems – Ralf Niemann, KluwerAcademic.
2. Design Principles of Distributed Embedded Applications – Hermann Kopetz,kluwer Academic.
3. Embedded Real-Time Systems Programming – Sriram V. Iyer and Pankaj Gupta,TMH.

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

Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks, perception model, feed forward neural network, Back propagation, Adaline, Widrow-Hoff's Adaline model, Madaline, Unsupervised learning neural network: Hopfield neural network, Competitive learning, self-organizing feature map, Reinforcement learning: Q-learning, Temporal difference learning.

Module 2 : Fuzzy Logic

Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, membership functions, Fuzzy set theory and operations, Extension principle of fuzzy set, fuzzy inference, Fuzzy implications, fuzzy relation, fuzzy reasoning , fuzzy c-means clustering , fuzzy inference Engine on VLSI architecture, Defuzzification techniques

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

Hybrid Systems: Neuro-fuzzy synergism, weakly coupled Neuro-fuzzy system, Tightly coupled Neuro-Fuzzy System, fuzzy-GA synergism, Neuro-GA, Adaptation of neural learning algorithm using GA

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:

1. Computational Intelligence Principles, Techniques and Applications, Amit Konar, Springer publication.
2. Neural Networks, Fuzzy Logic, and Genetic Algorithm (synthesis and Application) S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI
3. Principles of Soft Computing S.N.Sivanandam & S.N.Deepa,Wiley-India Edition

Reference Books:

1. Neuro Fuzzy and Soft Computing, J. S. R. JANG,C.T. Sun, E. Mitzutani, PHI
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

Basic concepts of Molecular Biology: Cellular Architecture, Nucleic Acids (RNA & DNA), DNA replication, Repair Cellular and recombination. Transcription, Translation, Genetic code, Gene expression, Protein structure and function, Molecular biology tools. Statistical methods: Estimation, Hypothesis testing, Random walks, Markov Models (HMM).

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:

1. N.C. Jones & P.A. Pevzner – An introduction to Bioinformatics Algorithms. The MIT Press-2004.
2. D. Gusifield-Algorithms on Strings, Trees and sequences, Cambridge University Press, 1997.
3. R. Durbin, S. Eddy, A. Krugh, G. Mithison-Biological Sequence analysis, Cambridge University Press,1998.
4. J. Setubal and J. Meidanis-Introduction to Computational Molecular Biology PWS Publishing Company, 1997.
5. W.J. Ewens & G.R. Grant-Statistical methods in Bioinformatics-Springer-1989.

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 beleveraged for analysis.The linkage data is essentially the graph structure of the social network and the communications between entities; whereas the contentdata 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

Limitations of current Web - Development of Semantic Web-Emergence of the Social Web-Social Network analysis: Development of Social Network Analysis -Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis. Types of networks, Tools for visualizing network data, review of graph theory basics.

Module – II

Structural properties of networks: Notions of centrality, cohesiveness of subgroups: clique, n-cliques, n-clans, n-clubs, k-flexes and k-cores. Roles and positions, structural equivalence, regular equivalence, automorphic equivalence, equitable partitions, stochastic block models and community structure in networks.

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

Mining Graphs: Community and cluster detection: Extracting evolution of Web Community from a Series of Web archive- Detecting communities in social networks- Definition of community- Evaluating communities- Methods for community detection and mining- Applications of community mining algorithms -Tools for detecting communities social network infrastructures and communities Decentralized online social networks- Multi Relational characterization of dynamic social network communities, random walks, spectral methods, link analysis for web mining: page rank, weighted page rank and hyper-link induced topic search(HITS) algorithms.

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:

1. Stanley Wasserman, Katherine Faust. Social network analysis: methods and applications. Cambridge University Press, 1994.
2. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.

References

1. Peter R. Monge, Noshir S. Contractor, Theories of communication networks. Oxford University Press, 2003.
2. Duncan Watts. Six degrees: the science of a connected age. Norton, 2004.

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

Introduction to VLSI Design methodologies, Review of Data structures and algorithms, Review of VLSI Design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, general purpose methods for combinatorial optimization.

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

1. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.
2. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

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 :

1. *Computers and Intractability: A Guide to the Theory of NP-Completeness*- Michael R. Garey, and David S. Johnson, W.H. Freeman, 1979.
2. *Computational Complexity* – C. H. Papadimitriou, Addison Wesley, 1994.

References:

1. Combinatorial Optimization: Algorithms and Complexity - Christos H. Papadimitriou.,Prentice-Hall, 1982.
2. Complexity Theory: A Modern Approach - Sanjeev Arora and Boaz Barak , CambridgeUniversity Press, 2009.
3. Computability and Complexity Theory - Steven Homer , Alan L. Selman, Springer, 2011

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

Probability Review, Generating Random Variables for Simulation, Sample Paths, Convergence and Averages, Little's Law and other Operational Laws, Modification for Closed Systems, Summarizing Measured Data, Comparing Systems Using Sample Data, Simple Linear Regression Models.

UNIT- III Simulation, Experimental Design and Analysis

Simulation : Introduction, Analysis of Simulation Results, Random-Number Generation, Testing Random-Number Generators, Random-Variate Generation, Commonly Used Distributions, Random-Variate Generation. Transient removal and termination criteria, Simulations with infinite-variance distributions.

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 :

1. Performance Evaluation of Computer Systems based on metrics and techniques.
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:

1. Raj Jain,"The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement,Simulation, and Modeling", WileyInterscience, 1991.

2. K.S. Trivedi,"Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2001.

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:
Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

UNIT-2
Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

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
Analytical Modelling of Parallel Programs: Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

UNIT-5
Programming Using the Message-Passing Paradigm: Principles of Message-Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

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