M.Tech (COMPUTER SCIENCE)
Department of CSE, JNTUHCEH
COURSE STRUCTURE
(Applicable for the Batch admitted from the Academic Year 2018-19 onwards)

I SEMESTER

S.No	Group Code	Group	Subject	L	T	P	Credits
1.		PC 1	Advanced Data Structures	3	0	0	3
2.		PC 2	Mathematical Foundations of Computer Science	3	0	0	3
3.		PE I	Program Elective I	3	0	0	3
4.		PE II	Program Elective II	3	0	0	3
5.		Laboratory 1	Advanced Data Structures Lab	0	0	4	2
6.		Laboratory 2	Based on Program Electives-I	0	0	4	2
7.		PW	Research Methodology & IPR	2	0	0	2
8.		Audit I	AUDIT COURSE I	2	0	0	0
TOTAL CREDITS				**16**	**-**	**8**	**18**

Program Elective I

1. Machine Learning
2. Cryptography & Network Security
3. Internet of Things

Program Elective II

1. Software Architectures
2. Information Retrieval Systems
3. Distributed Systems

II SEMESTER

S.No	Group Code	Group	Subject	L	T	P	Credits
1.		PC 3	Advanced Algorithms	3	0	0	3
2.		PC 4	Soft Computing	3	0	0	3
3.		PE III	Program Elective III	3	0	0	3
4.		PE IV	Program Elective IV	3	0	0	3
5.		Laboratory 3	Advanced Algorithms Lab	0	0	4	2
6.		Laboratory 4	Based on Program Electives-III	0	0	4	2
7.		PW	MINI PROJECT with Seminar	2	0	0	2
8.		Audit II	AUDIT COURSE II	2	0	0	0
TOTAL CREDITS				**16**	**-**	**8**	**18**

Program Elective III

1. Digital Forensics
2. Data Analytics
3. Parallel Computing

Program Elective IV

1. Human Computer Interaction
2. Computer Vision
3. Distributed Databases

III SEMESTER

S.No	Group Code	Group	Subject	L	T	P	Credits
1.		PE V	Program Elective V	3	0	0	3
2.		OEC	Open Elective	3	0	0	3
3.		PW	PROJECT/ DISSERTATION PHASE - I	0	0	20	10
TOTAL CREDITS				**6**	**-**	**20**	**16**

Program Elective V

1. Optimization Techniques
2. High Performance Computing
3. Ad hoc and Sensor Networks

IV SEMESTER

S.No	Group Code	Group	Subject	L	T	P	Credits
1.		PW	PROJECT/ DISSERTATION PHASE - II	0	0	32	16
TOTAL CREDITS						**32**	**16**

OPEN ELECTIVES

1. Data Analytics
2. Advanced Data Structures

ADVANCED DATA STRUCTURES

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Prerequisites

1. A course on " Data Structures"

Objectives

1. Introduces the heap data structures such as leftist trees, binomial heaps, fibonacci and min-max heaps
2. Introduces a variety of data structures such as disjoint sets, hash tables, search structures and digital search structures

Outcomes

1. Ability to select the data structures that efficiently model the information in a problem
2. Ability to understand how the choice of data structures impact the performance of programs
3. Can Design programs using a variety of data structures, including hash tables, search structures and digital search structures

UNIT - I

Heap Structures

Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT - II

Hashing and Collisions

Introduction, Hash Tables, Hash Functions, different Hash Functions:- Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT - III

Search Structures

OBST, AVL trees, Red-Black trees, Splay trees,

Multiway Search Trees

B-trees., 2-3 trees

UNIT - IV

Digital Search Structures

Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT - V

Pattern matching

Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String , Harspool, Rabin Karp

Textbooks

1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms, TH Cormen, PHI

References

1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Universities Press.

MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Pre-requisites

1. No prerequisites
2. An understanding of Math in general is sufficient.

Objectives

1. Introduces the elementary discrete mathematics for computer science and engineering.
2. Topics include formal logic notation, methods of proof, induction, sets, relations, graph theory, permutations and combinations, counting principles; recurrence relations and generating functions.

Outcomes

1. Ability to understand and construct precise mathematical proofs
2. Ability to use logic and set theory to formulate precise statements
3. Ability to analyze and solve counting problems on finite and discrete structures
4. Ability to describe and manipulate sequences
5. Ability to apply graph theory in solving computing problems

UNIT - I

The Foundations: Logic and Proofs

Propositional Logic, Applications of Propositional Logic, Propositional Equivalence, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference, Introduction to Proofs, Proof Methods and Strategy.

UNIT - II

Basic Structures, Sets, Functions, Sequences, Sums, Matrices and Relations

Sets, Functions , Sequences & Summations, Cardinality of Sets and Matrices Relations**,** Relations and Their Properties, n-ary Relations and Their Applications, Representing Relations, Closures of Relations, Equivalence Relations, Partial Orderings.

UNIT - III

Algorithms, Induction and Recursion

Algorithms, The Growth of Functions, Complexity of Algorithms.

Induction and Recursion

Mathematical Induction, Strong Induction and Well-Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Correctness.

UNIT - IV

Discrete Probability and Advanced Counting Techniques

An Introduction to Discrete Probability . Probability Theory, Bayes' Theorem, Expected Value and Variance.

Advanced Counting Techniques

Recurrence Relations, Solving Linear Recurrence Relations, Divide-and-Conquer Algorithms and Recurrence Relations, Generating Functions, Inclusion-Exclusion, Applications of Inclusion-Exclusion.

UNIT - V

Graphs

Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Coloring.

Trees

Introduction to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimum Spanning Trees.

Text Books

1. Discrete Mathematics and Its Applications with Combinatorics and Graph Theory- Kenneth H Rosen, 7th Edition, TMH.

Reference

1. Discrete Mathematical Structures with Applications to Computer Science-J.P. Tremblay and R. Manohar, TMH,
2. Discrete Mathematics for Computer Scientists & Mathematicians: Joe L. Mott, Abraham Kandel, Teodore P. Baker, 2nd ed. , Pearson Education.
3. Discrete Mathematics- Richard Johnsonbaugh, 7Th Edtn., Pearson Education.
4. Discrete Mathematics with Graph Theory- Edgar G. Goodaire, Michael M. Parmenter.
5. Discrete and Combinatorial Mathematics - an applied introduction: Ralph.P. Grimald, 5th edition , Pearson Education,.

MACHINE LEARNING
(Program Elective - I)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Prerequisites

1. Data Structures
2. Knowledge on statistical methods

Objectives

1. This course explains machine learning techniques such as decision tree learning, Bayesian learning etc.
2. To understand computational learning theory.
3. To study the pattern comparison techniques.

Outcomes

1. Understand the concepts of computational intelligence like machine learning
2. Ability to get the skill to apply machine learning techniques to address the real time problems in different areas
3. Understand the Neural Networks and its usage in machine learning application.

UNIT - I

Introduction

Well-posed learning problems, designing a learning system Perspectives and issues in machine learning

Concept learning and the general to specific ordering

Introduction, A concept learning task, concept learning as search, Find-S: Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination algorithm, Remarks on Version Spaces and Candidate Elimination, Inductive Bias.

Decision Tree Learning

Introduction, Decision Tree Representation, Appropriate Problems for Decision Tree Learning, The Basic Decision Tree Learning Algorithm Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Issues in Decision Tree Learning.

UNIT - II

Artificial Neural Networks

Introduction, Neural Network Representation, Appropriate Problems for Neural Network Learning, Perceptions, Multilayer Networks and the Back propagation Algorithm.

Discussion on the Back Propagation Algorithm, An illustrative Example: Face Recognition

Evaluation Hypotheses

Motivation, Estimation Hypothesis Accuracy, Basics of Sampling Theory, A General Approach for Deriving Confidence Intervals, Difference in Error of Two Hypotheses, Comparing Learning Algorithms.

UNIT - III

Bayesian learning

Introduction, Bayes Theorem, Bayes Theorem and Concept Learning Maximum Likelihood and Least Squared Error Hypotheses, Maximum Likelihood Hypotheses for Predicting Probabilities, Minimum Description Length Principle , Bayes Optimal Classifier, Gibs Algorithm, Naïve Bayes Classifier, An Example: Learning to Classify Text, Bayesian Belief Networks, EM Algorithm.

Computational Learning Theory

Introduction, Probably Learning an Approximately Correct Hypothesis, Sample Complexity for Finite Hypothesis Space, Sample Complexity for Infinite Hypothesis Spaces, The Mistake Bound Model of Learning.

Instance-Based Learning

Introduction, k-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning, Remarks on Lazy and Eager Learning.

UNIT - IV

Pattern Comparison Techniques

Temporal patterns, Dynamic Time Warping Methods, Clustering, Codebook Generation, Vector Quantization

Pattern Classification

Introduction to HMMS, Training and Testing of Discrete Hidden Markov Models and Continuous Hidden Markov Models, Viterbi Algorithm, Different Case Studies in Speech recognition and Image Processing

UNIT - V

Analytical Learning

Introduction, Learning with Perfect Domain Theories : PROLOG-EBG Remarks on Explanation-Based Learning, Explanation-Based Learning of Search Control Knowledge, Using Prior Knowledge to Alter the Search Objective, Using Prior Knowledge to Augment Search Operations.

Combining Inductive and Analytical Learning

Motivation, Inductive-Analytical Approaches to Learning, Using Prior Knowledge to Initialize the Hypothesis.

Text Books

1. Machine Learning – Tom M.Mitchell,-MGH
2. Fundamentals of Speech Recognition By Lawrence Rabiner and Biing – Hwang Juang.

References

1. Machine Learning : An Algorithmic Perspective, Stephen Marsland, Taylor & Francis

CRYPTOGRAPHY & NETWORK SECURITY
(Program Elective - I)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Prerequisites
1. A Course on "Computer Networks

Objectives
1. To impart knowledge on network security issues, services, goals and mechanisms.
2. To analyze the security of communication systems, networks and protocols.
3. To apply algorithms used for secure transactions in real world applications

Outcomes
1. Demonstrate the knowledge of cryptography and network security concepts and applications.
2. Ability to apply security principles in system design.
3. Ability to identify and investigate vulnerabilities and security threats and mechanisms to counter them.

UNIT - I
Security Attacks
(Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Internet Standards and RFCs, Buffer overflow & format string vulnerabilities, TCP session hijacking, ARP attacks, route table modification, UDP hijacking, and man-in-the-middle attacks.

UNIT - II
Conventional Encryption
Principles, Conventional encryption algorithms (DES, AES, RC4, Blowfish), cipher block modes of operation, location of encryption devices, key distribution Approaches of Message Authentication, Secure Hash Functions and HMAC.

UNIT - III
Number Theory
Modular Arithmetic, Euclid's Algorithm, Fermat's and Euler's Theorem, Chinese Remainder Theorem, Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service.

UNIT - IV
Email privacy
Pretty Good Privacy (PGP) and S/MIME.
IP Security
Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT - V
Web Security
Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET).
Intruders, Viruses and related threats, Firewall Design principles, Trusted Systems, Intrusion Detection Systems.

Text Books

1. Cryptography and Network Security, William Stallings, 3rd Edition, Pearson Education.
2. Applied Cryptography, Bruce Schneier, 2nd Edition, Wiley Publisher.

References

1. Cryptography and Network Security, Behrouz A.Forouzan, 2nd edition, Tata McGraw-Hill Education.

INTERNET OF THINGS
(Program Elective - I)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Prerequisites: NIL

Objectives

1. To introduce the terminology, technology and its applications
2. To introduce the raspberry PI platform, that is widely used in IoT applications
3. To introduce the implementation of web based services on IoT devices

Outcomes

1. Understand the new computing technologies
2. Able to apply the latest computing technologies like cloud computing technology and Big Data
3. Ability to introduce the concept of M2M (machine to machine) with necessary protocols
4. Get the skill to program using python scripting language which is used in many IoT devices

UNIT - I

Introduction to Internet of Things

Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

UNIT - II

IoT and M2M

Software defined networks, network function virtualization, difference between SDN and NFV for IoT Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER

UNIT - III

Introduction to Python

Language features of Python, Data types, data structures, Control of flow, functions, modules, packaging, file handling, data/time operations, classes, Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT - IV

IoT Physical Devices and Endpoints

Introduction to Raspberry PI-Interfaces (serial, SPI, I2C) Programming – Python program with Raspberry PI with focus of interfacing external gadgets, controlling output, reading input from pins.

UNIT - V

IoT Physical Servers and Cloud Offerings

Introduction to Cloud Storage models and communication APIs Webserver – Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API

Text Books

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

SOFTWARE ARCHITECTURES
(Program Elective - II)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Pre Requisite

1. A course On "Software Engineering"

Objectives

1. To understand the concept of software architecture
2. To understand the design, documentation of software Architecture and Reconstruct.
3. To understand importance of Architecture Evaluation and Methods.
4. To understand reusability of Architecture

Outcomes

1. Students can Design, document and Reconstruct Software Architecture
2. Students have profound knowledge on Software Architecture
3. Students can evaluate Architecture
4. Students can reuse the Architecture

UNIT - I

Envisioning Architecture

The Architecture Business Cycle, What is Software Architecture, Architectural patterns, reference models, reference architectures, architectural structures and views.
A-7E – A case study in utilizing architectural structures

UNIT - II

Creating an Architecture

Understanding Quality Attributes, Achieving qualities, Architectural styles and patterns
Air Traffic Control – a case study in designing for high availability

UNIT - III

Designing the Architecture

Documenting software architectures, Reconstructing Software Architecture
Flight Simulation – a case study in Architecture for Integrability

UNIT - IV

Analyzing Architectures

Architecture Evaluation, Architecture design decision making, ATAM, CBAM.
The Nightingale System - a case study in Applying the ATAM
The NASA ECS Project – a case study in Applying the CBAM

UNIT - V

Moving from one system to many

Software Product Lines, Building systems from off the shelf components, Software architecture in future.
Celsius Tech – a case study in product line development

Text Books

1. Software Architecture in Practice, , Len Bass, Pau Clements & Rick Kazman, second edition Pearson Education,2003.

References

1. Beyond Software architecture, Luke Hohmann, Addison wesley, 2003.
2. Software architecture, David M. Dikel, David Kane and James R. Wilson, Prentice Hall PTR, 2001
3. Software Design, David Budgen, second edition, Pearson education, 2003

INFORMATION RETRIEVAL SYSTEMS
(Program Elective - II)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

Prerequisites:

1. Data Structures

Objectives:

1. To learn the important concepts and algorithms in IRS
2. To understand the data/file structures that are necessary to design, and implement information retrieval (IR) systems.

Outcomes:

1. Ability to apply IR principles to locate relevant information large collections of data
2. Ability to design different document clustering algorithms
3. Implement retrieval systems for web search tasks.
4. Design an Information Retrieval System for web search tasks.

UNIT - I

Introduction

Motivation, Basic Concepts, Past-Present and Future, the Retrieval Process

Modelling

Introduction, A Taxonomy of Information retrieval Models, Retrieval: Ad hoc and Filtering, A Formal Characteristics of IR Models, Classic Information Retrieval, Alternative Set Theory Models, Alternative Probabilistic Models, Structured Text Retrieval Models, Model for Browsing

UNIT - II

Retrieval Evaluation

Introduction, retrieval Performance Evaluation, Reference Collections

Query languages

Introduction, Keyword-Based Querying, Pattern Matching, Structural Queries, Query Protocols

Query Operations

Introduction, User Relevance Feedback, Automatic Local Analysis, Automatic global Analysis

Text Operations

Introduction, Document Preprocessing, Document Clustering, Text Compression, Comparing text Compression Techniques

UNIT - III

Indexing and Searching

Introduction, Inverted Files, Other Indices for Text, Boolean queries, Sequential Searching, pattern Matching, Structural Queries, Compression

Searching the Web

Introduction, Challenges, Characterizing the Web, Search Engines, Browsing, Metasearches, Finding the Needle in the Haystack, Searching using Hyperlinks

UNIT - IV

User Interfaces and Visualization

Introduction, human-Computer Interaction, The Information Access Process, Starting Points, Query Specification, Context, User Relevance Judgments, Interface Support for the Search Process

UNIT - V

Multimedia IR: Models and Languages
Introduction, Data Modeling, Query Languages
Multimedia IR: Indexing and |Searching
Introduction, Background-Spatial Access Methods,A Generic Multimedia Indexing Approach, One Dimentional Time Series, wo dimential Color Images, Automatic Feature Extraction.

Text Books

1. Modern Information Retrival By Yates and Neto Pearson Education.

References

1. Kowalski, Gerald, Mark T Maybury: Information Retrieval Systems: Theory and Implementation, Kluwer Academic Press, 1997.
2. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval Data Structures and Algorithms, Prentice Hall, 1992.
3. Information Storage & Retieval By Robert Korfhage – John Wiley & Sons.

DISTRIBUTED SYSTEMS
(Program Elective - II)

M.Tech, CS. I Sem

L	T	P	C
3	0	0	3

rerequisites

1. A course on " Operating Systems"
2. A course on "Network Security and Cryptography"

Objectives

1. This course provides an insight into Distributed systems.
2. Topics include- Peer to Peer Systems, Transactions and Concurrency control, Security and Distributed shared memory

Outcomes

1. Ability to understand Transactions and Concurrency control.
2. Ability to understand Security issues.
3. Understanding Distributed shared memory.
4. Abilty to design distributed systems for basic level applications.

UNIT - I

Characterization of Distributed Systems

Introduction,Examples of Distributed systems,Resource sharing and web,challenges,System models-Introduction,Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication, Distributed objects and Remote Invocation-Introduction,Communication between distributed objects,RPC,Events and notifications, Case study-Java RMI.

UNIT - II

Operating System Support

Introduction, OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture, Distributed File Systems-Introduction, File Service architecture

Case study

SUN network file systems.

Name Services

Introduction, Name Services and the Domain Name System,Case study of the Global Name Service, Case study of the X.500 Directory Service.

UNIT - III

Peer to Peer Systems

Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore.

Time and Global States

Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging.

Coordination and Agreement

Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.

UNIT - IV

Transactions and Concurrency control

Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed

Transactions

Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery

Replication

Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data.

UNIT - V

Security

Introduction, Overview of Security techniques, Cryptographic algorithms, Digital signatures

Case studies

Kerberos,TLS,802.11 WiFi.

Distributed shared memory, Design and Implementation issues, Sequential consistency and Ivy case study, Release consistency and Munin case study,Other consistency models, CORBA case study-Introduction,CORBA RMI,CORBA Services.

Text Books

1. Distributed Systems Concepts and Design, G Coulouris, J Dollimore and T Kindberg, Fourth Edition, Pearson Education.
2. Distributed Systems,S.Ghosh,Chapman&Hall/CRC,Taylor&Francis Group,2010.

References

1. Distributed Computing,S.Mahajan and S.Shah,Oxford University Press.
2. Distributed Operating Systems Concepts and Design,Pradeep K.Sinha,PHI.
3. Advanced Concepts in Operating Systems, M Singhal, N G Shivarathri, TMH.
4. Reliable Distributed Systems,K.P.Birman,Springer.
5. Distributed Systems – Principles and Paradigms, A.S. Tanenbaum and M.V. Steen, PearsonEducation.
6. Distributed Operating Systems and Algorithm Analysis,R.Chow,T.Johnson,Pearson.
7. Distributed Operating Systems,A.S.Tanenbaum,Pearson education.
8. Distributed Computing,Principles,Algorithms and Systems,Ajay D.Kshemakalyani and Mukesh Singhal,Cambridge,rp 2010.

ADVANCED DATA STRUCTURES LAB

M.Tech, CS. I Sem

L	T	P	C
0	0	4	2

Prerequisites

1. A course on Computer Programming & Data Structures"

Objectives

1. Introduces the basic concepts of Abstract Data Types.
2. Reviews basic data structures such as stacks and queues.
3. Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs, and B-trees.
4. Introduces sorting and pattern matching algorithms

Outcomes

1. Ability to select the data structures that effeciently model the information in a problem.
2. Ability to assess efficiency trade-offs among different data structure implementations or combinations.
3. Implement and know the application of algorithms for sorting and pattern matching.
4. Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and B-trees.

List of Programs

1. Write a program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.

2. Write a program for implementing the following sorting methods:
   a) Merge sort b) Heap sort c) Quick sort

3. Write a program to perform the following operations:
   a) Insert an element into a B- tree.
   b) Delete an element from a B- tree.
   c) Search for a key element in a B- tree.

4. Write a program to perform the following operations:
   a) Insert an element into a Min-Max heap
   b) Delete an element from a Min-Max heap
   c) Search for a key element in a Min-Max heap

5. Write a program to perform the following operations:
   a) Insert an element into a Lefiist tree
   b) Delete an element from a Leftist tree
   c) Search for a key element in a Leftist tree

6. Write a program to perform the following operations:
   a) Insert an element into a binomial heap
   b) Delete an element from a binomial heap.
   c) Search for a key element in a binomial heap

7. Write a program to perform the following operations:
   a) Insert an element into a AVL tree.
   b) Delete an element from a AVL search tree.
   c) Search for a key element in a AVL search tree.

8. Write a program to perform the following operations:
   a) Insert an element into a Red-Black tree.
   b) Delete an element from a Red-Black tree.
   c) Search for a key element in a Red-Black tree.

9. Write a program to implement all the functions of a dictionary using hashing.

10. Write a program for implementing Knuth-Morris-Pratt pattern matching algorithm.

11. Write a program for implementing Brute Force pattern matching algorithm.

12. Write a program for implementing Boyer pattern matching algorithm.

Text Books

1. Fundamentals of Data structures in C, E.Horowitz, S.Sahni and Susan Anderson Freed, 2nd Edition, Universities Press
2. Data Structures Using C – A.S.Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson education.
3. Introduction to Data Structures in C, Ashok Kamthane, 1st Edition, Pearson.

References

1. The C Programming Language, B.W. Kernighan, Dennis M.Ritchie, PHI/Pearson Education
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3. Data structures: A Pseudocode Approach with C, R.F.Gilberg And B.A.Forouzan, 2nd Edition, Cengage Learning.

MACHINE LEARNING LAB

M.Tech, CS. I Sem

L	T	P	C
0	0	4	2

Objective

1. The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.

Outcomes

After the completion of the "**Machine Learning**" lab, the student can able to:

1. Understand complexity of Machine Learning algorithms and their limitations;
2. Understand modern notions in data analysis oriented computing;
3. Be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
4. Be capable of performing experiments in Machine Learning using real-world data.

List of Experiments

2. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is theprobability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result. (Ans: 15%)

3. Extract the data from database using python

4. Implement k-nearest neighbours classification using python

5. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

6. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium skiing design single twenties no -> highRisk
high golf trading married forties yes -> lowRisk
low speedway transport married thirties yes -> medRisk
medium football banking single thirties yes -> lowRisk
high flying media married fifties yes -> highRisk
low football security single twenties no -> medRisk
medium golf media single thirties yes -> medRisk
medium golf transport married forties yes -> lowRisk
high skiing banking single thirties yes -> highRisk
low golf unemployed married forties yes -> highRisk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of `golf' and the conditional probability of `single' given `medRisk' in the dataset?

7. Implement linear regression using python.
8. Implement Naïve Bayes theorem to classify the English text
9. Implement an algorithm to demonstrate the significance of genetic algorithm
10. Implement the finite words classification system using Back-propagation algorithm

Text Books

1. Machine Learning – Tom M.Mitchell,-MGH
2. Fundamentals of Speech Recognition By Lawrence Rabiner and Biing – Hwang Juang.

References

1. Machine Learning : An Algorithmic Perspective, Stephen Marsland, Taylor & Francis

CRYPTOGRAPHY & NETWORK SECURITY LAB

M.Tech, CS. I Sem

L	T	P	C
0	0	4	2

Objectives

1. To know about various encryption techniques.
2. To understand the concept of Public key cryptography.
3. To study about message authentication and hash functions
4. To impart knowledge on Network security

Outcomes

1. Identify some of the factors driving the need for network security
2. Identify and classify particular examples of attacks
3. Define the terms vulnerability, threat and attack
4. Identify physical points of vulnerability in simple networks
5. Compare and contrast symmetric and asymmetric encryption systems and their vulnerability to attack, and explain the characteristics of hybrid systems.

List of Experiments

1. Write a client-server program where client sends a text message to server and server sends the text message to client by changing the case(uppercase and lowercase) of each character in the message.
2. Write a client-server program to implement following classical encrytion techniques:
   ceaser cipher
   transposition cipher
   row substitution cipher
   hill cipher
3. Install JCrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security and Management

Tools:

1. Perform an experiment to demonstrate how to sniff for router traffic by using the tool wireshark
2. Using nmap
   a) Find open ports on a system
   b) Find the machines which are active
   c) Find the version of remote os on other systems
   d) Find the version of s/w installed on other system

Ethical Hacking:

1. Setup a honey pot and monitor the honey pot on network
2. Write a script or code to demonstrate SQL injection attacks
3. Create a social networking website login page using phishing techniques
4. Write a code to demonstrate DoS attacks
5. Install rootkits and study variety of options

Text Books

1. Cryptography and Network Security, William Stallings, 3rd Edition, Pearson Education.
2. Applied Cryptography, Bruce Schneier, 2nd Edition, Wiley Publisher.

References

1. Cryptography and Network Security, Behrouz A.Forouzan, 2nd edition, Tata McGraw-Hill Education.

INTERNET OF THINGS (IoT) LAB

M.Tech, CS. I Sem

L	T	P	C
0	0	4	2

Objectives

1. To introduce the raspberry PI platform, that is widely used in IoT applications
2. To introduce the implementation of distance sensor on IoT devices

Outcomes

1. Ability to introduce the concept of M2M (machine to machine) with necessary protocols and get awareness in implementation of distance sensor
2. Get the skill to program using python scripting language which is used in many IoT devices

List of Experiments

1. Using raspberry pi
    a. Calculate the distance using distance sensor.
    b. Basic LED functionality.
2. Using Arduino
    a. Calculate the distance using distance sensor.
    b. Basic LED functionality.
    c. Calculate temperature using temperature sensor.
3. Using Node MCU
    a. Calculate the distance using distance sensor.
    b. Basic LED functionality.

    Calculate temperature using temperature sensor.

Text Books

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

RESEARCH METHODOLOGIES & IPR

M.Tech, CS. I Sem

L	T	P	C
2	0	0	2

Objective

1. Introduce research paper writing and induce paper publication skills.
2. Give the introduction to Intellectual Property Rights

Outcomes

Gain the sound knowledge of the following important elements:

1. Ability to distinguish research methods
2. Ability to write and publish a technical research paper
3. Ability to review papers effectively
4. IPR and Patent filing

UNIT - I

Introduction

Objective of Research; Definition and Motivation; Types of Research; Research Approaches; Steps in Research Process; Criteria of Good Research; Ethics in Research.

Research Formulation and Literature Review:

Problem Definition and Formulation; Literature Review; Characteristics of Good Research Question; Literature Review Process.

UNIT - II

Data Collection

Primary and Secondary Data; Primary and Secondary Data Sources; Data Collection Methods; Data Processing; Classification of Data.

Data Analysis

Statistical Analysis; Multivariate Analysis; Correlation Analysis; Regression Analysis; Principle Component Analysis; Samplings

UNIT - III

Research Design

Need for Research Design; Features of a Good Design; Types of Research Designs; Induction and Deduction.

Hypothesis Formulation and Testing

Hypothesis; Important Terms; Types of Research Hypothesis; Hypothesis Testing; Z-Test; t-Test; f-Test; Making a Decision; Types of Errors; ROC Graphics.

UNIT - IV

Test Procedures

Parametric and Non Parametric Tests; ANOVA; Mann-Whitney Test; Kruskal-Wallis Test; Chi-Square Test; Multi-Variate Analysis

Presentation of the Research Work

Business Report; Technical Report; Research Report; General Tips for Writing Report; Presentation of Data; Oral Presentation; Bibliography and References; Intellectual Property Rights; Open-Access Initiatives; Plagiarism.

UNIT - V

Law of Patents, Patent Searches, Ownership, Transfer Patentability Design Patents

Double Patenting – Patent Searching – Patent Application Process – Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents. Ownership Rights – Sole and Joint Inventors – Inventions Made by Employees and Independent Contractors – Assignment of Patent Rights – Licensing of Patent Rights – Invention Developers and Promoters.

Patent Infringement, New Developments and International Patent Law

Direct Infringement **-** Inducement to Infringe – Contributory Infringement – First Sale Doctrine – Claims Interpretation – Defenses to Infringement – Remedies for Infringement – Resolving an Infringement Dispute – Patent Infringement Litigation. New Developments in Patent Law

Text Books

1. Research Methodology. Methods & Technique : Kothari. C.R.

2. Intellectual Property – Copyrights, Trademarks, and Patents by Richard Stim, Cengage Learning

References

1. Practical Research : planning and Design(8th Edition) – Paul D. Leedy and Jeanne E. Ormrod.
2. A Hand Book of Education Research – NCTE
3. Methodology of Education Research – K.S. Sidhu.
4. Tests, Measurements and Research methods in Behavioural Sciences- A.K. Singh.
5. Statistical Methods- Y.P. Agarwal.
6. Methods of Statistical Ananlysis- P.S Grewal.
7. Fundamentals of Statistics – S.C. Gupta, V.K. Kapoor.
8. Intellectual Property Rights by Deborah E. Bouchoux, Cengage Learning.
9. Managing Intellectual Property – The Strategic Imperative, Vinod V.Sople, 2nd Edition, PHI Learning Private Limited.
10. Research methodology – S.S. Vinod Chandra, S. Anand Hareendran

ADVANCED ALGORITHMS

M.Tech, CS II Sem

L	T	P	C
3	0	0	3

Prerequisites

1. A course on "Computer Programming & Data Structures"
2. A course on "Advanced Data Structures & Algorithms"

Objectives

1. Introduces the recurrence relations for analyzing the algorithms
2. Introduces the graphs and their traversals.
3. Describes major algorithmic techniques (divide-and-conquer, greedy, dynamic programming, Brute Force , Transform and Conquer approaches) and mention problems for which each technique is appropriate;
4. Describes how to evaluate and compare different algorithms using worst-case, average-case and best-case analysis.
5. Introduces string matching algorithms
6. Introduces linear programming.

Outcomes

1. Ability to analyze the performance of algorithms
2. Ability to choose appropriate data structures and algorithm design methods for a specified application
3. Ability to understand how the choice of data structures and the algorithm design methods impact the performance of programs

UNIT - I

Classification of algorithms, Algorithm Specifications, Mathematical analysis of Recursive Algorithms

Introduction to recurrence equations, formulation of recurrence equations, Techniques for solving recurrence equations, Solving recurrence equations, Solving Recurrence Equations using polynomial reduction, Divide and conquer recurrences

UNIT - II

Graphs

Graph representations, Graph traversals

Brute Force Approaches

Computational Geometry Problems-Closest pair problem, Convex Hull Problem, Exhaustive Searching- Magic Squares problem, Container Loading problem, Knapsack Problem, Assignment Problem

UNIT - III

Divide and Conquer approach

Multiplication of long integers, Strassen's matrix multiplication, Fourier Transform

Greedy algorithms:- Coin change problem, Scheduling problems, knapsack problem, optimal storage on tapes, optimal tree problems, optimal graph problems

UNIT - IV

Transform and Conquer approach

Matrix operations- Gaussian Elimination method, LU decomposition, Crout's method of decomposition

Dynamic Programming

Computing binomial coefficients, Multistage graph problem, Transitive Closure and Warshall algorithm, Floyd warshall all pairs shortest path problem, TSP, Flow shop scheduling algorithm

UNIT - V

String algorithms

Basic string algorithms, Longest Common Subsequences.

Linear Programming, Graphical method for solving LPP, Simplex method, Minimization problems, Principle of Duality, Max Flow problem

Text Books

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

References

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein,PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education

SOFT COMPUTING

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Course Objectives

1. Familiarize with soft computing concepts
2. Introduce and use the idea of fuzzy logic and use of heuristics based on human experience
3. Familiarize the Neuro-Fuzzy modeling using Classification and Clustering techniques
4. Learn the concepts of Genetic algorithm and its applications
5. Acquire the knowledge of Rough Sets.

Course Outcomes

On completion of this course, the students will be able to:

1. Identify the difference between Conventional Artificial Intelligence to Computational Intelligence.
2. Understand fuzzy logic and reasoning to handle and solve engineering problems
3. Apply the Classification and clustering techniques on various applications.
4. Understand the advanced neural networks and its applications
5. Perform various operations of genetic algorithms, Rough Sets.
6. Comprehend various techniques to build model for various applications

UNIT-I

Introduction to Soft Computing: Evolutionary Computing, "Soft" computing versus "Hard" computing, Soft Computing Methods, Recent Trends in Soft Computing, Characteristics of Soft computing, Applications of Soft Computing Techniques.

UNIT-II

Fuzzy Systems: Fuzzy Sets, Fuzzy Relations, Fuzzy Logic, Fuzzy Rule-Based Systems

UNIT-III

Fuzzy Decision Making, Particle Swarm Optimization,

UNIT-IV

Genetic Algorithms: Basic Concepts, Basic Operators for Genetic Algorithms, Crossover and Mutation Properties, Genetic Algorithm Cycle, Fitness Function, Applications of Genetic Algorithm.

UNIT-V

Rough Sets, Rough Sets, Rule Induction, and Discernibility Matrix, Integration of Soft Computing Techniques.

Text Books

1. Soft Computing – Advances and Applications - Jan 2015 by B.K. Tripathy and J. Anuradha – Cengage Learning

References:

1. S. N. Sivanandam & S.N.Deepa, "Principles of Soft Computing", 2nd edition, Wiley India, 2008.
2. David E. Goldberg, "*Genetic Algorithms-In Search, optimization and Machine learning*", Pearson Education.
3. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education 2004.
4. G.J. Klir & B. Yuan, "*Fuzzy Sets & Fuzzy Logic*", PHI, 1995.
5. Melanie Mitchell, "*An Introduction to Genetic Algorithm*", PHI, 1998.
6. Timothy J. Ross, "*Fuzzy Logic with Engineering Applications*", McGraw- Hill International ditions, 1995

DIGITAL FORENSICS
(Program Elective - III)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Objectives

After going through this subject students can able to:

1. Know the history and evaluation of digital forensics
2. Describe various types of cyber crime
3. Understand benefits of forensics
4. Implement forensics readiness plan

Outcomes

1. Interpret and appropriately apply the laws and procedures associated with identifying, acquiring, examining and presenting digital evidence.
2. Create a method for gathering, assessing and applying new and existing legislation and industry trends specific to the practice of digital forensics

UNIT - I

Computer Forensics Fundamentals

Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology — Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined — Data Back-up and Recovery — The Role of Back-up in Data Recovery — The Data-Recovery Solution.

UNIT - II

Evidence Collection and Data Seizure

Why Collect Evidence? Collection Options — Obstacles — Types of Evidence — The Rules of Evidence — Volatile Evidence — General Procedure — Collection and Archiving — Methods of Collection — Artifacts — Collection Steps — Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps — Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication — Practical Consideration —Practical Implementation.

UNIT - III

Computer Forensics analysis and validation

Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, performing remote acquisitions

Network Forensics

Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project.

Processing Crime and Incident Scenes

Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case

UNIT - IV

Current Computer Forensic tools

Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-Mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.

Cell phone and mobile device forensics

Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices.

UNIT - V

Working with Windows and DOS Systems

Understanding file systems, exploring Microsoft File Structures, Examining NTFS disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS startup tasks, virtual machines.

Text Books

1. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
2. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning

Reference Books

1. Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison-Wesley Pearson Education
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.
3. Computer Evidence Collection & Presentation by Christopher L.T. Brown, Firewall Media.
4. Homeland Security, Techniques & Technologies by Jesus Mena, Firewall Media.
5. Software Forensics Collecting Evidence from the Scene of a Digital Crime by Robert M. Slade, TMH 2005
6. Windows Forensics by Chad Steel, Wiley India Edition.

DATA ANALYTICS
(Program Elective - III)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Objectives

1. To explore the fundamental concepts of data analytics.
2. To learn the principles and methods of statistical analysis
3. Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
4. To understand the various search methods and visualization techniques.

Outcomes

After completion of this course students will be able to

1. Understand the impact of data analytics for business decisions and strategy
2. Carry out data analysis/statistical analysis
3. To carry out standard data visualization and formal inference procedures
4. Design Data Architecture
5. Understand various Data Sources

UNIT - I

Data Management

Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data Quality(noise, outliers, missing values, duplicate data) and Data Processing & Processing.

UNIT - II

Data Analytics

Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

UNIT - III

Regression

Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.

Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT - IV

Object Segmentation

Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc.

Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction

UNIT - V

Data Visualization

Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

Text books

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

References

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
3. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand RajaramanMilliway Labs Jeffrey D Ullman Stanford Univ.

PARALLEL COMPUTING
(Program Elective – III)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Prerequisites

1. Computer Organization & Architecture
2. Operating Systems
3. Programming for problem solving

Objectives

1. To introduce the foundations of parallel Computing
2. To learn various parallel computing architectures and programming models
3. To gain knowledge of writing efficient parallel programs

Outcomes

1. Ability to understand the concepts of parallel architectures
2. Ability to select the data structures that efficiently model the information in a problem.
3. Ability to develop an efficient parallel algorithm to solve it.
4. Ability to implement an efficient and correct code to solve it, analyse its performance

UNIT - I

Parallel Computing

Introduction, Motivation and scope - Parallel Programming Platforms – Basic Communication Operations

UNIT - II

Principles of Parallel Algorithm Design

Analytical Modelling of Parallel Programs

UNIT - III

Programming using Message Passing Paradigm(MPI)

Programming Shared Address Space Platforms(PThreads)

UNIT - IV

Dense Matric Algorithms (Matrix-Vector Multiplication , Matrix-Matrix Multiplication)

Sorting Algorithms (Issues, Bubble Sort, Quick Sort, Bucket Sort, Enumeration Sort, Radix Sort)

UNIT - V

Graph Algorithms (Minimum Spanning Tree: Prim's Algorithm

Single-Source Shortest Paths: Dijkstra's Algorithm) Search Algorithms (DFS, BFS)

Text Book

1. Introduction to Parallel Computing, Second Edition, Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Addison-Wesley, 2003, ISBN: 0201648652

References

1. Parallel Computing – Theory and Practice, Second Edition, Michaek J. Quinn, Tata McGraw-Hill Edition.
2. Parallel Computers – Architectures and Programming, V. Rajaraman, C. Siva Ram Murthy,PHI.

HUMAN COMPUTER INTERACTION
(Program Elective - IV)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Objectives

1. To understand the design principles of developing a Human Computer Interface (HCI).
2. To learn tools and devices required for designing a good interface

Outcomes

1. Acquire knowledge on principles and components of HCI.
2. Analyze product usability evaluations and testing methods
3. Design an effective user interface for software application using the building tools and techniques

UNIT - I

Introduction

Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design

The graphical user interface

Popularity of graphics, direct manipulation, graphical system, Characteristics, Web user – interface popularity, characteristics- Principles of user interface.

UNIT - II

Design process

Human interaction with computers, important of human characteristics in design, human considerations in design, Human interaction speeds, understanding business junctions.

UNIT - III

Screen Designing

Interface design goals, Screen meaning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow, Visually pleasing composition, amount of information, focus and emphasis, presenting information simply and meaningfully, information retrieval on web, statistical graphics, Technological consideration in interface design.

UNIT - IV

Windows

Window characteristics, components of a window, presentation styles, types, management, organizing window functions, operations

Selection of device based and screen based controls.

UNIT - V

Write clear text and messages

Create meaningful Graphics, Icons, Images, Choose proper colors

Interaction Devices

Keyboard and function keys, pointing devices, speech recognition digitization and generation, image and video displays, drivers.

Text Books

1. Wilbent. O. Galitz ,“The Essential Guide To User Interface Design”, Second Edition, Wiley India Edition

2. Ben Sheiderman, “Designing The User Interface”, Third Edition, Addison-Wesley

Reference

1. Alan Cooper, “The Essential Of User Interface Design”, Wiley – Dream Tech Ltd., 2002.

COMPUTER VISION
(Program Elective - IV)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Objectives

1. To review image processing techniques for computer vision
2. To understand shape and region analysis
3. To understand Hough Transform and its applications to detect lines, circles, ellipses
4. To understand three-dimensional image analysis techniques
5. To understand motion analysis
6. To study some applications of computer vision algorithms

Outcomes

Upon Completion of the course, the students will be able to

1. To implement fundamental image processing techniques required for computer vision
2. To perform shape analysis
3. To implement boundary tracking techniques
4. To apply chain codes and other region descriptors
5. To apply Hough Transform for line, circle, and ellipse detections
6. To apply 3D vision techniques
7. To implement motion related techniques
8. To develop applications using computer vision techniques

UNIT - I
Image Processing Foundations

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture

UNIT - II
Shapes and regions

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures –active contours – shape models and shape recognition – centroidal profiles – handling occlusion –boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments

UNIT - III
Hough Transform

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform – spatial matched filtering – GHT for ellipse detection – object location– GHT for feature collation

UNIT - IV
3D Vision And Motion

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – splinebased motion – optical flow – layered motion

UNIT - V

Applications

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians

Text Books

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012.

References

1. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
2. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
4. D. L. Baggio et al., "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
5. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

DISTRIBUTED DATABASES
(Program Elective - IV)

M.Tech, CS. II Sem

L	T	P	C
3	0	0	3

Prerequisites

1. A course on "Database Management Systems"

Objectives

1. To acquire knowledge on parallel and distributed databases and its applications.
2. To study the usage and applications of Object Oriented databases.
3. To learn the modeling and design of databases
4. To acquire knowledge on parallel and distributed databases and its applications.
5. Equip students with principles and knowledge of parallel and object oriented databases.
6. Topics include distributed DBMS architecture and design; query processing and optimization; distributed transaction management and reliability; parallel and object database management systems.

Outcomes

1. Understand theoretical and practical aspects of distributed database systems.
2. Study and identify various issues related to the development of distributed database system.
3. Understand the design aspects of object oriented database system and related development.
4. Ability to write global queries for distributed databases.

UNIT - I

Distributed Databases: An Overview

Features of Distributed versus Centralized Databases, Principles of Distributed Databases, **Levels Of Distribution Transparency**

Reference Architecture for Distributed Databases, Types of Data Fragmentation, Integrity Constraints in Distributed Databases, Distributed Database Design

UNIT - II

Translation of Global Queries to Fragment Queries

Equivalence transformations for Queries, Transforming Global Queries into Fragment Queries, Distributed Grouping and Aggregate Function Evaluation, Parametric Queries.

Optimization of Access Strategies, A Framework for Query Optimization, Join Queries, General Queries

UNIT - III

The Management of Distributed Transactions

A Framework for Transaction Management, Supporting Atomicity of Distributed Transactions, Concurrency Control for Distributed Transactions, Architectural Aspects of Distributed Transactions

Concurrency Control, Foundation of Distributed Concurrency Control, Distributed Deadlocks, Concurrency Control based on Timestamps, Optimistic Methods for Distributed Concurrency Control.

UNIT - IV

Reliability

Basic Concepts, Nonblocking Commitment Protocols, Reliability and concurrency Control, Determining a Consistent View of the Network, Detection and Resolution of Inconsistency, Checkpoints and Cold Restart, Distributed Database Administration, Catalog Management in Distributed Databases, Authorization and Protection

UNIT - V

Architectural Issues

Alternative Client/Server Architectures, Cache Consistency, Object Management, Object Identifier Management, Pointer Swizzling, Object Migration, Distributed Object Storage, Object Query Processing, Object Query Processor Architectures, Query Processing Issues, Query Execution, Transaction Management, Transaction Management in Object DBMSs, Transactions as Objects

Database Integration, Scheme Translation, Scheme Integration, Query Processing Query Processing Layers in Distributed Multi-DBMSs, Query Optimization Issues Transaction Management Transaction and Computation Model, Multidatabase Concurrency Control, Multidatabase Recovery, Object Orientation and Interoperability, Object Management Architecture CORBA and Database interoperability, Distributed Component Object Model, COM/OLE and Database Interoperability, PUSH-Based Technologies

Text books

1. Distributed Databases Principles & Systems, Stefano Ceri, Giuseppe Pelagatti,TMH.
2. Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez , Pearson Education, 2nd Edition.

References

1. Distributed Database Systems,Chanda Ray,Pearson.
2. Distributed Database Management Systems,S.K.Rahimi and Frank.S.Haug, Wiley.

ADVANCED ALGORITHMS LAB

M.Tech, CS. II Sem

L	T	P	C
0	0	4	2

Objective

The student can able to attain knowledge in advance algorithms.

Outcomes

The student can able to analyze the performance of algorithms

List of Experiments

1. Implement assignment problem using Brute Force method
2. Perform multiplication of long integers using divide and conquer method.
3. Implement solution for knapsack problem using Greedy method.
4. Implement Gaussian elimination method.
5. Implement LU decomposition
6. Implement Warshall algorithm
7. Implement Rabin Karp algorithm.
8. Implement KMP algorithm.
9. Implement Harspool algorithm
10. Implement max-flow problem.

Text Books

1. Design and Analysis of Algorithms, S.Sridhar, OXFORD University Press

References

1. Introduction to Algorithms, second edition, T.H.Cormen, C.E.Leiserson, R.L.Rivest and C.Stein,PHI Pvt. Ltd./ Pearson Education.
2. Fundamentals of Computer Algorithms, Ellis Horowitz, Satraj Sahni and Rajasekharam, Universities Press.
3. Design and Analysis of algorithms, Aho, Ullman and Hopcroft, Pearson education

DIGITAL FORENSICS LAB
(Program Elective – III)

M.Tech, CS. II Sem

L	T	P	C
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Objectives

1. To provide students with a comprehensive overview of collecting, investigating, preserving, and presenting evidence of cyber crime left in digital storage devices, emails, browsers, mobile devices using different Forensics tools
2. To Understand file system basics and where hidden files may lie on the disk, as well as how to extract the data and preserve it for analysis.
3. Understand some of the tools of e-discovery.
4. To understand the network analysis ,Registry analysis and analyse attacks using different forensics tools

Outcomes

1. Learn the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing
2. To Learn the file system storage mechanisms and retrieve files in hidden format
3. Learn the use of computer forensics tools used in data analysis.
4. Learn how to find data that may be clear or hidden on a computer disk, find our the open ports for the attackers through network analysis , Registry analysis.

List of Experiments

1. **Perform email analysis** using the tools like Exchange EDB viewer , MBOX viewer and View user mailboxes and public folders , Filter the mailbox data based on various criteria, Search for particular items in user mailboxes and public folders
2. **Perform Browser history analysis** and get the downloaded content , history ,saved logins,s earches ,websites visited etc using Foxton Forensics tool,Dumpzilla .
3. **Perform mobile analysis** in the form of retrieving call logs ,SMS log ,all contacts list using the forensics tool like SAFT
4. **Perfrom Registry analysis** and get boottime logging using process monitor tool
5. **Perform Disk imaging and cloning the** using the X-way Forensics tools
6. **Perform Data Analysis i.e** History about open file and folder, and view folder actions using Lastview activity tool
7. **Perform Network analysis** using the Network Miner tool **.**
8. **Perform information for incident response** using the crowd Response tool
9. **Perform File type detection using** Autospy tool
10. **Perform Memory capture and analysis** using the Live RAM capture or any forensic tool

Text Books

1. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
2. Computer Forensics and Investigations by Nelson, Phillips Enfinger, Steuart, CENGAGE Learning

References

1. Real Digital Forensics by Keith J. Jones, Richard Bejtiich, Curtis W. Rose, Addison-Wesley Pearson Education
2. Forensic Compiling, A Tractitioneris Guide by Tony Sammes and Brian Jenkinson, Springer International edition.
3. Computer Evidence Collection & Presentation by Christopher L.T. Brown, Firewall Media.
4. Homeland Security, Techniques & Technologies by Jesus Mena, Firewall Media.
5. Software Forensics Collecting Evidence from the Scene of a Digital Crime by Robert M. Slade, TMH 2005
   Windows Forensics by Chad Steel, Wiley India Edition.

DATA ANALYTICS LAB
(Data Analytics Using R)

M.Tech, CS. II Sem

L	T	P	C
0	0	4	2

Objectives

1. To provide an overview of a new language R used for data Analytics.
2. To present the basic techniques for extracting information from large datasets
3. To familiarize students with how various statistics like mean median etc. can be collected for data exploration.
4. Predict outcomes with supervised learning techniques and Unearth the patterns with unsupervised techniques

Outcomes

After completion of this course students will be able to

1. Understand different files formats like .csv and .txt and learn how access these files.
2. Work on Data preprocessing methods
3. Understand various Data Sources
4. Carry out statistical analysis
5. Understand various techniques to visualize results of data.

List of Experiments

1. Demonstrate data cleaning – missing values
2. Implement data normalization (min-max, z-score)
3. Implement attribute subset selection for data reduction
4. Demonstrate outlier detection
5. Perform analytics on any standard data set
6. Implement linear regression
7. Implement logistic regression
8. Construct decision tree for weather data set
9. Analyze time-series data
10. Work on any data visualization tool

Text books

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

Reference books

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
3. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand RajaramanMilliway Labs Jeffrey D Ullman Stanford Univ.

PARALLEL COMPUTING LAB

(Program Elective – III)

M.Tech, CS. II Sem

L	T	P	C
0	0	4	2

Prerequisites

1. Computer Organization & Architecture
2. Operating Systems
3. Programming for problem solving

Objectives

1. To introduce the foundations of parallel Computing
2. To learn various parallel computing architectures and programming models
3. To gain knowledge of writing efficient parallel programs

Outcomes

1. Ability to understand the concepts of parallel architectures
2. Ability to select the data structures that efficiently model the information in a problem.
3. Ability to develop an efficient parallel algorithm to solve it.
4. Ability to implement an efficient and correct code to solve it, analyze its performance

List of Programs

1. Design a parallel program to implement Matrix-Vector and Matrix-Matrix Multiplication using MPI library.
2. Design a parallel program to implement Bubble Sort using OpenMP and Pthread Programming Constructs.
3. Design a parallel program to implement Quick Sort using OpenMP and Pthread Programming Constructs.
4. Design a parallel program to implement Bucket Sort using OpenMP and Pthread Programming Constructs.
6. Design a parallel program to implement Prim's Algorithm using OpenMP and Pthread Programming Constructs.
7. Design a parallel program to implement DFS Algorithm using OpenMP and Pthread Programming Constructs.
8. Design a parallel program to implement BFS Algorithm using OpenMP and Pthread Programming Constructs.
9. Design a parallel program to implement Dijkstra's Algorithm using MPI library.

Text Book

1. Introduction to Parallel Computing, Second Edition, Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Addison-Wesley, 2003, ISBN: 0201648652

References

1. Parallel Computing – Theory and Practice, Second Edition, Michaek J. Quinn, Tata McGraw-Hill Edition.
2. Parallel Computers – Architectures and Programming, V. Rajaraman, C. Siva Ram Murthy,PHI.

OPTIMIZATION TECHNIQUES
(Program Elective – V)

M.Tech, CS. III Sem

L	T	P	C
3	0	0	3

Prerequisites
1. A course on "Mathematics"

Objectives
1. This course explains various optimization problems and the techniques to address those problems.
2. To study Linear Programming, dynamic programming and optimization Techniques etc.
3. To understand the theory of games.

Outcomes
1. Gain the knowledge of optimization techniques
2. Get the skill to apply Optimization techniques to address the real time problems .

UNIT – I
Introduction
Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.
Allocation
Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

UNIT – II
Transportation Problem
Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.
Assignment problem
Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

UNIT - III
Sequencing
Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines
Replacement
Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

UNIT - IV
Theory Of Games
Introduction –Terminology– Solution of games with saddle points and without saddle points- 2x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.
Inventory
Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

UNIT - V

Waiting Lines

Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

Dynamic Programming

Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

Text Books

1. Operation Research /J.K.Sharma/MacMilan.
2. Introduction to O.R /Taha/PHI

References

1. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspan and Lawrence Friedman
2. Operations Research /A.M.Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
3. Operations Research / Wagner/ PHI Publications.
4. Introduction to O.R/Hillier & Libermann (TMH).

HIGH PERFORMANCE COMPUTING
(Program Elective – V)

M.Tech, CS. III Sem

L	T	P	C
3	0	0	3

Prerequisites
1. Computer Organization & Architecture
2. Operating System Programming

Objectives
1. To Improve the system performance
2. To learn various distributed and parallel computing architecture
3. To learn different computing technologies

Outcomes
1. Understanding the concepts in grid computing
2. Ability to set up cluster and run parallel applications
3. Ability to understand the cluster projects and cluster OS
4. Understanding the concepts of pervasive computing & quantum computing.

UNIT - I

Grid Computing: Data & Computational Grids, Grid Architectures And Its Relations To Various Distributed Technologies. Autonomic Computing, Examples Of The Grid Computing Efforts (IBM).

UNIT - II

Cluster Computing at a Glance: Introduction, A Cluster Computer and its Architecture, Cluster Classifications, Commodity Components for clusters, Network Services/Communication SW, Cluster Middleware and SSI, RMS, Programming Environments and Tools, Cluster Applications

Cluster Setup & Its Administration : Introduction, Setting up the cluster, Example Cluster System – Beowlf;

Lightweight Messaging Systems: Introduction, Latency Bandwidth Evaluation of Communication performance, Traditional Communication Mechanisms for clusters, Lightweight Communication Mechanisms

UNIT - III

Job and Resource Management Systems : Need of Job management, Components and Architecture. **Scheduling Parallel Jobs on Clusters :** Introduction, Rigid Jobs with process migration, Malleable Jobs with Dynamic Parallelism, Communication-Based Coscheduling, Batch Scheduling. **Cluster Operating Systems:** COMPaS

UNIT - IV

Pervasive Computing Concepts & Scenarios: Hardware & Software; Human – Machine Interface.

Device Connectivity: Java For Pervasive Devices; Application Examples.

UNIT - V

Classical Vs Quantum Logic Gates; One, Two & Three Qubit Quantum Gates; Fredkin & Toffoli Gates; Quantum Circuits; Quantum Algorithms.

Text Book

1. Grid Computing, J. Joseph & C. Fellenstien, Pearson Education
2. High Performance Cluster Computing, Raj kumar Buyya, pearson Education.
3. Pervasive Computing, J. Burkhardt et.al, Pearson Education
4. Approaching Quantum Computing Marivesar, Pearson Education.

References

1. The Grid 2: Blue Print for a New Computing Infrastructure, Ian Foster and Carl Kesselman, 2nd Edition, The Elsevier Series.
2. Quantum computing and Quantum Information, Neilsen & Chung L:, Cambridge University Press.
3. A networking approach to Grid Computing , Minoli , Wiley

ADHOC & SENSOR NETWORKS
(Program Elective – V)

M.Tech, CS. III Sem

L	T	P	C
3	0	0	3

Prerequisites
1. Computer Networks
2. Distributed Systems
3. Mobile Computing

Objectives
1. To understand the concepts of sensor networks
2. To understand the MAC and transport protocols for adhoc networks
3. To understand the security of sensor networks
4. To understand the applications of adhoc and sensor networks

Outcomes
1. Understanding the state of the art research in emerging subject of ad hoc and wireless sensor networks (ASN)
2. Ability to solve the issues in real-time application development based on ASN
3. Ability to conduct further research in the ASN domain

UNIT - I

Introduction to Ad Hoc Networks

Characteristics of MANETs, Applications of MANETs and Challenges of MANETs.

Routing in MANETs

Criteria for classification, Taxonomy of MANET routing algorithms, *Topology-based* routing algorithms-Proactive: DSDV, WRP; Reactive: DSR, AODV, TORA; Hybrid: ZRP; *Position-based* routing algorithms-Location Services-DREAM, Quorum-based, GLS; Forwarding **Strategies**

Greedy Packet, Restricted Directional Flooding-DREAM, LAR; Other routing algorithms-QoS Routing, CEDAR.

UNIT - II

Data Transmission

Broadcast Storm Problem, Rebroadcasting Schemes-Simple-flooding, Probability-based Methods, Area-based Methods, Neighbour Knowledge-based: SBA, Multipoint Relaying, AHBP. Multicasting: Tree-based: AMRIS, MAODV; Mesh-based: ODMRP, CAMP; Hybrid: AMRoute, MCEDAR and Geocasting: Data-transmission Oriented-LBM; Route Creation Oriented-GeoTORA, MGR.

UNIT - III

Geocasting

Data-transmission Oriented-LBM; Route Creation Oriented-GeoTORA, MGR**.**

TCP over Ad Hoc TCP protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc

UNIT - IV

Basics of Wireless, Sensors and Lower Layer Issues

Applications, Classification of sensor networks, Architecture of sensor network, Physical layer, MAC layer, Link layer, Routing Layer.

UNIT - V

Upper Layer Issues of WSN

Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs, Sensor Networks and mobile robots.

Text Books

1. Ad Hoc and Sensor Networks – Theory and Applications, *Carlos Corderio Dharma P.Aggarwal,* World Scientific Publications, March 2006, ISBN – 981-256-681-3
2. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science, ISBN – 978-1-55860-914-3 (Morgan Kauffman)

DATA ANALYTICS
(Open Elective - PG)

M.Tech, CS. III Sem

L	T	P	C
3	0	0	3

Objectives

1. To explore the fundamental concepts of data analytics.
2. To learn the principles and methods of statistical analysis
3. Discover interesting patterns, analyze supervised and unsupervised models and estimate the accuracy of the algorithms.
4. To understand the various search methods and visualization techniques.

Outcomes

After completion of this course students will be able to

1. Understand the impact of data analytics for business decisions and strategy
2. Carry out data analysis/statistical analysis
3. To carry out standard data visualization and formal inference procedures
4. Design Data Architecture
5. Understand various Data Sources

UNIT - I

Data Management

Design Data Architecture and manage the data for analysis, understand various sources of Data like Sensors/Signals/GPS etc. Data Management, Data Quality(noise, outliers, missing values, duplicate data) and Data Processing & Processing.

UNIT - II

Data Analytics

Introduction to Analytics, Introduction to Tools and Environment, Application of Modeling in Business, Databases & Types of Data and variables, Data Modeling Techniques, Missing Imputations etc. Need for Business Modeling.

UNIT - III

Regression

Concepts, Blue property assumptions, Least Square Estimation, Variable Rationalization, and Model Building etc.

Logistic Regression: Model Theory, Model fit Statistics, Model Construction, Analytics applications to various Business Domains etc.

UNIT - IV

Object Segmentation

Regression Vs Segmentation – Supervised and Unsupervised Learning, Tree Building – Regression, Classification, Overfitting, Pruning and Complexity, Multiple Decision Trees etc.

Time Series Methods: Arima, Measures of Forecast Accuracy, STL approach, Extract features from generated model as Height, Average Energy etc and Analyze for prediction

UNIT - V

Data Visualization

Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

Text books

1. Student's Handbook for Associate Analytics – II, III.
2. Data Mining Concepts and Techniques, Han, Kamber, 3rd Edition, Morgan Kaufmann Publishers.

References

1. Introduction to Data Mining, Tan, Steinbach and Kumar, Addision Wisley, 2006.
2. Data Mining Analysis and Concepts, M. Zaki and W. Meira
3. Mining of Massive Datasets, Jure Leskovec Stanford Univ. Anand RajaramanMilliway Labs Jeffrey D Ullman Stanford Univ.

ADVANCED DATA STRUCTURES
(Open Elective - PG)

M.Tech, CS. III Sem

L	T	P	C
3	0	0	3

Prerequisites
1. A course on " Data Structures"

Objectives
1. Introduces the heap data structures such as leftist trees, binomial heaps, fibonacci and min-max heaps
2. Introduces a variety of data structures such as disjoint sets, hash tables, search structures and digital search structures

Outcomes
1. Ability to select the data structures that efficiently model the information in a problem
2. Ability to understand how the choice of data structures impact the performance of programs
3. Can Design programs using a variety of data structures, including hash tables, search structures and digital search structures

UNIT - I
Heap Structures
Introduction, Min-Max Heaps, Leftist trees, Binomial Heaps, Fibonacci heaps.

UNIT - II
Hashing and Collisions
Introduction, Hash Tables, Hash Functions, different Hash Functions:- Division Method, Multiplication Method, Mid-Square Method, Folding Method, Collisions

UNIT - III
Search Structures
OBST, AVL trees, Red-Black trees, Splay trees,
Multiway Search Trees
B-trees., 2-3 trees

UNIT - IV
Digital Search Structures
Digital Search trees, Binary tries and Patricia, Multiway Tries, Suffix trees, Standard Tries, Compressed Tries

UNIT - V
Pattern matching
Introduction, Brute force, the Boyer –Moore algorithm, Knuth-Morris-Pratt algorithm, Naïve String , Harspool, Rabin Karp

Textbooks
1. Fundamentals of data structures in C++ Sahni, Horowitz, Mehatha, Universities Press.
2. Introduction to Algorithms, TH Cormen, PHI

References
1. Design methods and analysis of Algorithms, SK Basu, PHI.
2. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Universities Press.