University Institute of Technology (UIT)

Silver Wood Estate, H. P. University, Shimla-171005

(NAAC Accredited "A-Grade" University)

DEPARTMENT of

COMPUTER SCIENCE ENGINEERING

Course Structure & Syllabus

for

Master of Technology

in

Computer Science Engineering

Semester I-IV

Effective for the Batch 2021-2023 and onwards

SCHEME AND SYLLABI FOR M. TECH DEGREE PROGRAMME IN COMPUTER SCIENCE ENGINEERING

SEMESTER I

Subject Code	Subject	Schedule of Teaching			Schedule of Examination		
		L	P	Credits	IA	Ext.	Total
HSMC-101	Research Methodology	4	0	4	50	100	150
MT-CSE 101	Advanced Computer Architecture	4	0	4	50	100	150
MT-CSE 102	Advanced Operating system	4	0	4	50	100	150
MT-CSE 103	Advanced Computer Networks	4	0	4	50	100	150
MT-CSE-ES	Elective I	4	0	4	50	100	150
MT- CSE104	Computer Networks Lab	0	2	2	25	25	50
TOTAL		**20**	**2**	**22**	**275**	**525**	**800**

Elective –I	
ES-01	Cyber Forensics
ES-02	Digital Image Processing
ES-03	Natural Language Processing
ES-04	Graph Theory and Optimization
ES-05	Quantum Computing

SEMESTER II

Subject Code	Subject	Schedule of Teaching			Schedule of Examination		
		L	P	Credits	IA	Ext.	Total
MT-CSE-201	Artificial Intelligence	4	0	4	50	100	150
MT-CSE-202	Analysis of Algorithms	4	0	4	50	100	150
MT-CSE-203	Data Science	4	0	4	50	100	150
MT-CSE-204	Cloud Computing	4	0	4	50	100	150
MT-CSE-ES	Elective II	4	0	4	50	100	150
MT-CSE-205	Analysis of Algorithms Lab	0	2	2	25	25	50
TOTAL		**20**	**2**	**22**	**275**	**525**	**800**

Elective II	
ES-06	Graphics and Multimedia
ES-07	Data Warehousing and Data Mining
ES-08	Human Computer Interaction
ES-09	Pattern Recognition Techniques
ES-10	Soft Computing

SEMESTER III

Subject Code	Subject	Schedule of Teaching	Schedule of Examination

		L	P	Credits	IA	Ext.	Total
MT-CSE-301	Social Network Analysis	4	0	4	50	100	150
MT-CSE-ES	Self-Study/ Elective III	4	0	4	50	100	150
MT-CSE- 302	Research Proposal	0	0	6	100	100	200
TOTAL		**8**	**0**	**14**	**250**	**350**	**500**

Elective III	
ES-11	VLSI Design
ES-12	Machine learning for Big Data
ES-13	Advanced Parallel Programming
ES-14	Distributed Database Management System

SEMESTER IV

Subject Code	Subject	Schedule of Teaching			Schedule of Examination		
		L	P	Credits	IA	Ext.	Total
MT-CSE-401	Dissertation	0	0	12	100	200	300
TOTAL		**0**	**0**	**12**	**100**	**200**	**300**

L – Lecture,

P – Practical

IA - Internal Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

Ext. - External Semester End Examination to be conducted by the University

Detailed Syllabus

Semester – I

Name of the Course	**Research Methodology**		
Course Code	**HSMC-101**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- Identify and discuss the issues and concepts salient to the research process.
- To formulate a viable research question.
- To distinguish probabilistic from deterministic explanations.
- To analyse the benefits and drawbacks of different methodologies.
- To understand how to prepare and execute a feasible research project.

Section	**Course Content**
Section-A	Research Aptitude**:** Meaning of Research, Objectives of Research, and Motivation in Research, Types of Research, Research Approaches, and Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is done. Research Process: Reviewing the literature, Formulation of research problem, Nature and type of variables, Hypothesis - meaning, types, development of hypothesis and its testing, Meaning & Functions of Research Design.

Section-B	Data Analysis: Sources, acquisition and interpretation of data, Quantitative and qualitative data, Graphical representation and mapping of data, Sensitivity Analysis with Data Tables, Optimization with EXCEL Solver, Summarizing Data with Histograms and Descriptive Statistics, Pivot Tables, Summarizing Data with database statistical functions, using correlation, Multiple Regression, Using Sampling to Analyse Data.
Section-C	Significance of Report Writing: Different Steps in writing Report, Layout of the Research Report, Types of Reports, Mechanics of Writing a Research Report, Art of scientific writing- Steps to better writing, flow method, organization of material and style, Drawing figures, graphs, tables, footnotes, references etc. in a research paper.
Section-D	Use of Internet in Research Work: Use of internet networks in research
	activities in searching material, paper downloading, submission of papers, relevant websites for journals and related research work. Introduction to Patent laws etc., process of patenting a research finding, Copy right, Cyber laws.

Course Outcomes:

CO1: Identify the complex issues inherent in selecting a research problem,
CO2: Select an appropriate research design, and implementing a research project.
CO3: Explain key research concepts and issues
CO4: Read, comprehend, and explain research articles in their academic discipline.

Text Book:

1. Kothari, C. R., "Research Methodology Methods and Techniques", Wiley Eastern Ltd.

References:

1. Wayne L. Winston, "Microsoft Excel Data Analysis and Business Modelling", Microsoft Press.
2. Kumar, "Research Methodology: A Step-by-Step Guide for Beginners", Pearson Education.
3. Dawson, C., "Practical Research Methods", UBSPD Pvt. Ltd.
4. Sharma, N. K., "Research Methodology", KSK Publishers.

Name of the Course	**Advanced Computer Architecture**		
Course Code	**MT-CSE-101**	Credits-4	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To offers a good understanding of the various functional units of a computer system.
- To prepare the student to be in a position to design a basic computer system.

Section	**Course Content**
Section-A	Parallel Computer Models : The State of Computing, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, Random Access Machines, VLSI Complexity Model Program and Networks Properties**:** Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms, System Interconnect Architectures.

Section-B	Principles of Scalable Performance: Performance Metrics and Measures, Speedup, Performance Laws, Scalability Analysis and Approaches Processors and Memory Hierarchy**:** Advance Processor Technology, Superscalar and Vector Processors, memory hierarchy technology, virtual memory technology.
Section-C	Multiprocessors and Multicomputer: Multiprocessor System Interconnects, Cache Coherence and Synchronization. Multivector and SIMD Computers: Vector Processing Principles, Multivector multiprocessors, compound vector processing, SIMD computer organizations, the connection machines.
Section-D	Parallel Models, languages and compilers: parallel programming models, parallel languages and compilers, dependence analysis of data arrays, code optimization and scheduling. Parallel program development and environment: parallel programming environments, synchronization and multiprocessing modes, shared variable program structures, message passing program development, domain decomposition techniques.

Course Outcomes:

CO1: Demonstrate concepts of parallelism in hardware/software.

CO2: Describe architectural features of advanced processors.

CO3: Interpret performance of Parallel Computer.

CO4: Explain how program can be decomposed for parallel execution

Text Books:

1. Kai Hwang: Advanced Computer Architecture: Parallelism, Scalability, Programmability, Tata McGraw-Hill.

Reference Books:

1. Parallel Computing – Theory and Practice by Michael J. Quinn, 2nd Edition, McGraw hill.
2. Design and Analysis of Parallel Algorithms by S.G. Akl, Prentice Hall.
3. Analysis and Design of Parallel Algorithms - Arithmetic and Matrix Problems, by S. Lakshmivarahan and S.K. Dhall, McGraw Hill International Edition.
4. A Practical Approach to Parallel Computing by S.K. Ghosal , Universities Press Limited
5. Computer Architecture and parallel processing by Hwang Briggs, McGrawHill, 1984.
6. Advanced Computer Architectures : A design space approach by Dezsosima, Terence Fountain, Peter Karsuk, Addison Wesley, 1997.

Name of the Course	**Advanced Operating System**		
Course Code	**MT-CSE-102**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- The aim of this module is to study, learn, and understand the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems); Hardware and software features that support these systems.

Section	**Course Content**

Section-A	Distributed Operating Systems: Introduction, Issues, Communication Primitives, Inherent Limitations, Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion, NonToken Based Algorithms, Lamport's Algorithm, Token Based Algorithms. Suzuki Kasami's Broadcast Algorithm, Distributed Deadlock Detection Issues, Centralized Deadlock Detection Algorithms, Distributed Deadlock Detection Algorithms, Agreement Protocols Classification, Solutions, Applications.
Section-B	Distributed Resource Management: Distributed File Systems, Design Issues, Distributed Shared Memory, Algorithms for Implementing Distributed Shared memory, Issues in Load Distributing, Scheduling Algorithms, Synchronous and Asynchronous Check Pointing and Recovery.
Section-C	Real Time And Mobile Operating Systems: Basic Model of Real Time Systems, Characteristics, Applications of Real Time Systems, Real Time Task Scheduling, Handling Resource Sharing, Mobile Operating Systems, Micro Kernel Design, Client Server Resource Access, Processes and Threads, Memory Management.
Section-D	Introduction To Android: Android Application package (APK), Working with Eclipse and Android, Application Design, Controls and User Interface, Basic Graphics ad View class, Using Google Maps in applications, Applications with multiple screens, Adding Menus and popup menus in applications, working with
	images, working with text files, tables and XML, building client server applications, Publishing your application.

Course Outcomes:

CO1: Acquire sufficient knowledge on distributed operating systems and management of resources in the same.

CO2: Possess real time knowledge on mobile operating systems with focus on Android.

CO3: Compare and evaluate different programming models for concurrent systems, their implementation,

CO4: Differentiate the issues that arise in designing real-time systems; analyse a variety of real-time scheduling techniques.

Text Books: **1.** Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems–Distributed, Database and Multiprocessor Operating Systems", Tata McGraw Hill.

2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Wiley India Pvt. Ltd.

3. Rajib Mall, "Real Time Systems: Theory and Practice", Pearson Education India.

Reference Books:

1. James C.S. "Android Application development", CENGAGE Learning.
2. Gargenta M., Nakamura M., "Learning Android", OREILLY Publishers.

Name of the Course	**Advanced Computer Networks**		
Course Code	**MT-CSE-103**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To impart knowledge about the network models and architectures.
- To introduce the fundamental concepts relevant to performance of various routing protocols and design of new routing protocol.
- To impart knowledge on designing and building a complete networking solution as per the requirement of an organization.

Section	Course Content
Section-A	Basic networking concepts revisited: introduction to networks, layering and link layer, network layer, routing, end-to-end layer, congestion control, Modeling and measurement: network traffic modeling, network measurement, simulation issues, network coding techniques.
Section-B	Routing and router design, scheduling and QoS, integrated and differentiated services, RSVP. Wireless networks and mobility supports, MAC protocol, routing, AODV, group communication, multicast
Section-C	Flow and congestion control, TCP variants, TCP modeling, active queue Management. Overlay networks: RON, P2P, CDN, Web caching, cross-layer optimizations, Emerging network types: data center, DTN, 4G mobile networks (LTE, Wi-Max). The internet protocols: TCP and UDP, Multicast routing, Mobility in networks, Mobile IP, Emerging trends in networking.
Section-D	Online social networks (OSN), wireless sensor networks (WSN) – cross-layer sensor data dissemination. Emerging applications – VoIP, SIP, video over P2P.

Course Outcomes:

CO1: to provide advanced background on relevant computer networking topics to have a comprehensive and deep knowledge in computer networks.

CO2: Develop an understanding of different components of computer networks, various protocols, modern technologies and their applications.

CO3: To understand how networking research is done

CO4: Understand wireless sensor networks and give networking solutions to organizations.

Text Books:

1. B.A. Forouzan, Data communication & networking, 5th Edition, Tata Mc-Graw Hills.
2. Andrew S. Tanenbaum, Computer Networks, Pearson Publications.
3. Robert Faludi, Building Wireless Sensor Network, O′Reilly Publisher. **Reference Book:**
1. L.L. Peterson and BS. Davie, Computer Networks ISE: A System Approach, 5th edition, Morgan Kaufman.
4. J.F. Kurose and K.W. Ross, Computer networking: A top-down approach, 6th edition, Adison Wesley.

Name of the Course	**Computer Networks Lab**		
Course Code	**MT-CSE-104**	**Credits-2**	L-0, T-0, P-2
Total Practical Sessions	10 (2hrs each)		
Semester End Examination: Max.Marks:25**,** Min.Marks:10 **Internal Assessment:** Max. Marks:25, Min.Marks:12			
Course Objectives: ❖ To provide hand-on experience on different topics in computer Networks.			

List of Experiments:

1. Experiments on LAN Trainer Kit:
   (i) Performance study of data link layer protocols
   (ii) Implementation and testing Network Layer routing protocols
   (iii) Understanding the steps involved in RC4 algorithm encryption
2. Programming exercises using sockets
3. Design and implementation of a Data Sniffer
4. Installation and working on various simulators viz. MATLAB, ETHEREAL, OMNET++, NS2, NS3, etc.
5. Simulation of routing protocols for wired and wireless networks.
6. Simulation of MAC protocols for wired and wireless LAN.
7. Implementation of searching techniques over big data.

Course Outcomes:

CO1: Understand the structure and organization of computer networks, and implementation of network layer routing protocols.

CO2: Understand the basic concepts of application layer protocol design and implementation of client/server models, peer to peer models.

CO3: Learn softwares used in Networking.

CO4: Ability to invoke analytical studies of Computer Networks through network simulation.

Text Books:

1. LAN Trainer user Manual
Stevens, W. R., "Unix Network Programming: Vol. II", 2nd Ed., Pearson Education,2002.

Semester - II

Name of the Course	**Artificial Intelligence**		
Course Code	**MT-CSE-201**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			
For Paper Setters: The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.			

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To provide a strong foundation of fundamental concepts in Artificial Intelligence.
- To provide a basic exposition to the goals and methods of Artificial Intelligence.
- To enable the student to apply these techniques in applications which involve perception, reasoning and learning?

Section	Course Content
Section-A	Introduction and Overview of Artificial intelligence, Intelligent Computer. Problems, Problem Spaces & Search: Problems &state Space Search Chess Problem, Water Jug Problem, Problem characteristics, Production system characteristics. Knowledge: Knowledge Representation: General concepts of knowledge representation Approaches &issues in knowledge representation Knowledge Based Systems, Knowledge Organization, Knowledge Manipulation, Acquisition of Knowledge.
Section-B	Formalized Symbolic logics – Syntax and Semantics for Propositional Logic, Properties of Wffs, Conversion to Clausal Form, Inference Rules, resolution, Dealing with Inconsistencies - Truth Maintenance Systems, Symbolic Reasoning under uncertainty, Statistical Reasoning. Structural Knowledge – Graph, frames and Related Structures.
Section-C	Natural Language Processing: Overview of Linguistics, Grammar and Languages, Syntactic Processing, Semantic Analysis, Morphological, Discourse and Pragmatic Processing, Natural Language Generation, Natural Language Systems, Parsing and its types.
Section-D	Expert Systems: Definition, applications, Rule Based System Architecture, Non Production System Architecture, Basic Components of E.S. Types of expert system.
	Overview of PROSPECTOR, MYCIN and DENDRAL. Basic function of PROSPECTOR, MYCIN AND DENDRAL Expert System.

Course Outcomes:

CO1: Understand concept of knowledge representation and predicate logic and transform the real life information in different representation.

CO2: Understand state space and its searching strategies.

CO3: Understand machine learning concepts and range of problems that can be handled by machine learning.

CO4: Apply the machine learning concepts in real life problems.

Text Books:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert systems." Prentice-Hall.
2. A. Rich and K. Knight, "Artificial Intelligence", Tata McGraw Hill.
3. ML for the Working Programmer by Larry Paulson, Cambridge University Press

Name of the Course	**Analysis of Algorithms**		
Course Code	**MT-CSE-202**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- The objective of this course is to teach students various data structures and to explain them algorithms for performing various operations on these data structures.
- To understand the notations used to analyse the Performance of algorithms.
- To choose the appropriate data structure for a specified application.

Section	Course Content
Section-A	Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data abstraction, Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures. Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circular linked lists- Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion. Representation of single, two dimensional arrays, sparse matrices-array and linked representations.
Section-B	Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Dequeue (Double ended queue), ADT, Array and linked implementations in C.
Section-C	Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree, array and linked representations of tree, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADT-implementationMax Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap. Graphs– Introduction, Definition, Terminology, Graph ADT, Graph Representations- Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.
Section-D	Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash
	tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods. Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees- Definition and Examples, Insertion into an AVL Tree, B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees (Elementary treatmentonly Definitions and Examples). Comparison of Search Trees. Pattern matching algorithm- The Knuth-MorrisPratt algorithm, Tries (examples only).

Course Outcomes:

CO1: Analyze the performance of various data structures

CO2: Select a suitable data structure for a given problem statement

CO3: Utilize the classes of Collection framework in implement various data structures

CO4: Understand tree data structure and its various types

Text Books:

1. Data Structures, S. Lipscutz, Schaum's Outlines, TMH.
2. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.

Reference Books:

1. Data structures A Programming Approach with C, D. S. Kushwaha and A. K. Misra, PHI

2. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.

Name of the Course	**Data Science**		
Course Code	**MT-CSE-203**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50
Instructions			

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To gain knowledge of Data Science
- Develop in depth understanding of the key technologies in data science and business analytics: data mining, machine learning, visualization techniques, predictive modeling, and statistics.

❖ Be familiar with Python and Panda

Section	Course Content
Section-A	Introduction and Importance of Data Science, - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Set - Type Conversion- Operators. Decision Making- Looping- Loop Control statement- Math and Random number functions. User defined functions - function arguments & its types.
Section-B	User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods - Python Exception Handling. OOPs Concepts Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance. NumPy Basics: Arrays and Vectorized Computation- The NumPy ndarray - Creating ndarrays - Data Types for ndarrays - Arithmetic with NumPy Arrays- Basic Indexing and Slicing - Boolean Indexing-Transposing Arrays and Swapping Axes. Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods-Sorting Unique and Other Set Logic
Section-C	Introduction to Pandas Data Structures: Series, Data Frame, Essential Functionality: Dropping Entries Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking. Summarizing and Computing
	Descriptive Statistics- Unique Values, Value Counts, and Membership. Reading and Writing Data in Text Format.

Section-D	Data Cleaning and Preparation: Handling Missing Data-Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Course Outcomes:

CO1: To have comprehensive knowledge of Data Science and working of Python and Panda as an advanced course.

CO2: To understand quantitative modeling and data analysis techniques to the solution of real world business problems, communicate findings, and effectively present results using data visualization techniques.

CO3: Learn principles of Data Science to the analysis of business problems.

CO4: Gain knowledge of statistical data analysis techniques utilized in business decision making.

Text Books

1. Y. Daniel Liang, "Introduction to Programming using Python", Pearson, 2012.
2. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and I Python", O'Reilly, 2nd Edition, 2018.

Reference Books

1. Wesley J. Chun, "Core Python Programming", Prentice Hall, 2006.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, 2017.

Name of the Course	**Cloud Computing**		
Course Code	**MT-CSE-204**	**Credits-4**	L-3, T-1, P-0

Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To understand the emerging area of "cloud computing" and how it relates to traditional models of computing.
- To impart fundamental concepts in the area of cloud computing.
- To impart knowledge in applications of cloud computing.
- Understanding the systems, protocols and mechanisms to support cloud computing

Section	Course Content
Section-A	Overview of Computing Paradigm: Recent trends in Computing ,Grid Computing, Cluster Computing, Distributed Computing, Utility Computing, Cloud Computing. Evolution of cloud computing, Business driver for adopting cloud computing. Introduction to Cloud Computing Cloud Computing (NIST Model),Introduction to Cloud Computing, History of Cloud Computing, Cloud serviceproviders,Properties,Characteristics&Disadvantages,Prosand Cons of Cloud Computing, Benefits of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing. Role of Open Standards.
Section-B	Cloud Computing Architecture Cloud computing stack, Comparison with traditional computing architecture (client/server), Services provided at various levels, How Cloud Computing Works, Role of Networks in Cloud computing, protocols used, Role of Web services. Service Models (XaaS): Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service(SaaS), Deployment Models: Public cloud, Private cloud, Hybrid cloud, Community cloud.
Section-C	Infrastructure as a Service (IaaS): Introduction to IaaS, IaaS definition, Introduction to virtualization, Different approaches to virtualization, Hypervisors, Machine Image, Virtual Machine(VM), Resource Virtualization: Server, Storage, Network Virtual Machine(resource)provisioning and

	manageability, storage as a service, Data storage in cloud computing (storage as a service) Platform as a Service (PaaS): Introduction to PaaS, What is PaaS, Service Oriented Architecture (SOA), Cloud Platform and Management, Computation & Storage, Software as a Service (PaaS): Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS.
Section-D	Service Management in Cloud Computing: Service Level Agreements(SLAs),Billing &Accounting, Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously ,Managing Data :Looking at Data, Scalability & Cloud Services, Database & Data Stores in Cloud ,Large Scale Data Processing Cloud Security: Infrastructure Security: Network level security, Host level security, Application level security, Data security and Storage, Data privacy and security Issues, Jurisdictional issues raised by Data location, Identity & Access Management, Access Control, Trust, Reputation, Risk. Authentication in cloud computing: Client access in cloud, Cloud contracting Model, Commercial and business considerations.

Course Outcomes:

CO1: Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.

CO2: Apply the fundamental concepts in data centres to understand the trade-offs in power, efficiency and cost.

CO3: Identify resource management fundamentals, i.e. resource abstraction, sharing and sandboxing and outline their role in managing infrastructure in cloud computing.

CO4: Analyze various cloud programming models and apply them to solve problems on the cloud.

Text Book:

1. Cloud Computing Bible,BarrieSosinsky,Wiley-India,2010 **Reference**

Books:

1. Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011.
2. Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012.
3. Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L.Krutz, Russell Dean Vines, Wiley-India, 2010.

Name of the Course	**Analysis of Algorithms Lab**		
Course Code	**MT-CSE-205**	**Credits-2**	L-0, T-0, P-2
Total Practical sessions	10(2hrs each)		
Semester End Examination: Max.Marks:25**,** Min.Marks:10 **Internal Assessment:** Max. Marks:25, Min.Marks:12			

Course Objectives:

- To write and execute programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables and search trees.
- To write and execute write programs in C/C++ to implement various sorting and searching methods.

List of Experiment

Week1: Write a C/C++ program that uses functions to perform the following: a) Create a singly linked list of integers.
b) Delete a given integer from the above linked list.
c) Display the contents of the above list after deletion.

Week2: Write a C/C++ program that uses functions to perform the following: a) Create a doubly linked list of integers.
b) Delete a given integer from the above doubly linked list.
c) Display the contents of the above list after deletion.

Week3: Write a C/C++ program that uses stack operations to convert a given infix expression into its postfix equivalent, Implement the stack using an array.

Week 4: Write C/C++ programs to implement a double ended queue ADT using i) Array and ii) Doubly linked list respectively.

Week 5: Write a C/C++ program that uses functions to perform the following: a) Create a binary search tree of characters.
b) Traverse the above Binary search tree recursively in postorder.

Week 6: Write a C/C++ program that uses functions to perform the following: a) Create a binary search tree of integers.
b) Traverse the above Binary search tree non recursively in in order.

Week 7: Write C/C++ programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Insertion sort b) Merge sort

Week 8: Write C/C++ programs for implementing the following sorting methods to arrange a list of integers in ascending order: a) Quick sort b) Selection sort

Course Outcomes:

CO1: Demonstrate a familiarity with major algorithms and data structures and their implementation.
CO2: Write rigorous correctness proofs for algorithms.
CO3: Analyze the asymptotic performance of algorithms.

CO4: Apply important algorithmic design paradigms and methods of analysis.
Text Books: 1. Understanding Pointers in C, Yashwant Kanetkar, BPB Publications 2. C and Data Structures, Prof. P.S. Deshpande and Prof. O.G. Kakde, Dreamtech Press. **Reference Books:** **1.** C and Data Structures, Third Edition, P. Padmanabham, BS Publications. **2.** Data structures using C, A. K. Sharma, 2nd edition, Pearson. **3.** Data Structures using C, R. Thareja, Oxford University Press. **4.** C and Data Structures, N. B. Venkateswarlu and E. V. Prasad, S. Chand.

Semester –III

Name of the Course	**Social Network Analysis**		
Course Code	**MT-CSE-301**	**Credits-4**	L-3, T-1, P-0

Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To make students aware about a range of social network analysis techniques & social network analysis softwares, so that students can work on an independent research project.

Section	Course Content
Section-A	Social Network Analysis: Preliminaries and definitions, Erdos Number Project, Centrality measures, Balance and Homophily. Random graph models: Random graphs and alternative models, Models of network growth, Navigation in social Networks.
Section-B	Network topology and diffusion, Contagion in Networks, Complex contagion, Percolation and information, Epidemics and information cascades. Cohesive subgroups, Multidimensional Scaling, Structural equivalence, roles and positions, Ego networks, Weak ties, Structural holes
Section-C	Small world experiments, small world models, origins of small world, Heavy tails, Small Diameter, Clustering of connectivity. The Erdos Renyi Model, Clustering Models, Preferential Attachment
Section-D	Navigation in Networks Revisited, Important vertices and page rank algorithm, towards rational dynamics in networks, basics of game theory. Coloring and consensus, biased voting, network formation games, network structure and equilibrium, behavioral experiments, Spatial and agent-based models.

Course Outcomes:
CO1: Understand a broad range of network concepts and theories.
CO2: Appreciate how network analysis can contribute to increasing knowledge about diverse aspects of society.
CO3: Analyse social network data using various software packages.
CO4: Present results from social network analysis, both orally and in writing.

Text Books:

1. S. Wasserman and K. Faust. Social Network Analysis: Methods and Applications (Cambridge, Cambridge University Press, 1994).
2. D. Easley and J. Kleinberg, Networks, Crowds and Markets: Reasoning about a highly connected world

LIST OF ELECTIVES

Semester-I

Name of the Course	**Cyber Forensics**		
Course Code	**MT-CSE-ES-01**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		

Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To impart knowledge about forensics and cyber laws.
- Utilize the knowledge of basic and applied sciences to deduce the solution of complex forensic problems.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the forensic lab professionals.
- To impart knowledge about host, network and multimedia forensics.

Section	Course Content
Section-A	Introduction to Forensics: Introduction to Incident, First Responder Procedure, Incident Response Methodology, Investigation Steps, Incident Handling, Investigation Reports, Setup of Cyber Forensics Lab, Cyber forensics Readiness, Introduction to Cyber Laws, Anti-forensics techniques.
Section-B	Evidence Collection and Handling: Evidence Collection from Computer, Smart phones, IoT, Cloud. Disk Imaging- Tools, Evidence Preservation, Write Blockers, Chain of Custody, Challenges in evidence handling, Understanding Files systems - Windows, Linux, Android, Concept of Slack space.
Section-C	Host Forensics: Memory Forensics, Malware Analysis, Reverse Engineering Tools, Encryption, Password Cracking, Rainbow tables, Recovery of deleted files, File carving.
Section-D	Network Forensics: Introduction to network protocols, Network packet analysis, Collecting Network Based Evidence, Network Intrusion detection, Investigating Routers, Email Tracing, Internet Fraud. Dark Web, TOR network, Application of Big Data techniques for Log Analysis. Multimedia Forensics and Case Studies: Image Forensics, Video Forensics, Audio Forensics, Steganography, Social Media Forensics, Identity theft, Corporate espionage, Online Defamation, Online harassment, mobile forensics,
	memory forensics.

Course Outcomes:

CO1: Learn the Basic Principles of Forensic Science.

CO2: Apply the knowledge acquired in Criminal Investigative procedures.

CO3: Be able to play an important role in quick decision-making processes.

CO4: Acquire and analyse the scientific data collected for application to the study and resolution of crime, investigation, civil and regulatory issues, and criminal identification.

CO5: Use the latest technology and analytical methods to convert the clues collected from a crime scene into evidence admissible in a court of law.

Text Books:

1. Digital Evidence and Computer Crime by Eoghan Casey, Academic Press.
2. Real Digital Forensics: Computer Security and Incident Response by Keith J. Jones, Richard Bejtlich and Curtis Wayne Rose, Addison-Wesley.

Reference Books:

1. File system forensic analysis by Brian Carrier, Addison-Wesley Professional.
2. Digital Forensics by André Årnes, Wiley.
3. A Practical Guide to Computer Forensics Investigations by Darren R. Hayes, Pearson IT Certification

Name of the Course	**Digital Image Processing**		
Course Code	**MT-CSE-ES-02**	**Credits-4**	L-3, T-1, P-0

Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques.
- To study image restoration procedures.
- To study the image compression procedures.

Section	Course Content
Section-A	Introduction to Computer Vision: Imaging basics, image Representation, Binary Image Analysis Image Vision: 2-D visual geometry, 3-D visual geometry, Applications of computer vision.
Section-B	Image Perception and Physical Modelling: Human visual system, Light, brightness, contrast, Colour modelling and representation. Image Acquisition and Display: Image Sensing using Single sensor, Image Sensing using Sensor strip, Image Sensing using sensor array, Image formation model. Image Enhancement: Functions used frequently for image enhancement, Histogram based approaches, Piece-wise linear transformation Functions.
Section-C	Image Filters and restoration: Spatial Filtering: Smoothing Spatial Filters, Sharpening Spatial Filters, Noise models of Image restoration:-Spatial and Frequency Properties of Noise**,** Some Important Noise Probability Density Functions**,** Periodic Noise Color Image Processing: Color Fundamentals, Color Models, Color Transformation, Smoothing and Sharpening, Color Image Compression.
Section-D	Image Compression coding: Huffman Coding, Run-Length Coding, LZW Coding, Bit-Plane Coding, Predictive Coding

	Image Analysis: Feature detection and extraction, Image segmentation, Detection of Isolated Points, Line detection, Edge Detection, Object Recognition: Structural Methods, Matching Shape Numbers, String Matching.

Course Outcome:

CO1: Review the fundamental concepts of a digital image processing system.
CO2 : Evaluate the techniques for image enhancement and image restoration.
CO3: Categorize various compression techniques.
CO4: Interpret Image compression standards.
CO5: Interpret image segmentation and representation techniques.

Text Books:

1. Digital Image Processing by Rafael C. Gonzalez & Ricahrd E. Woods-2002, Pearson Education Pte. Ltd.
2. Digital Image Processing by A.K.Jain, 1995,PHI **Reference Books:**
   1. Two-Tone Image Processing and Recognition, B.B. Choudhari, D.Dutta Majumdar, New Age International Publishers Ltd., New Delhi.

Name of the Course	**Natural Language Processing**

Course Code	**MT-CSE-ES-03**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed using in examinations.

Course Objectives:

- To introduce students about the techniques in natural language processing.
- To understand how system answers the goals of its designers, or meets the needs of its users.

Section	Course Content
Section-A	Introduction: Regular Expressions and Automata. , Morphology and Finite-State Transducers. Computational Phonology and Text-to-Speech, Probabilistic Models of Pronunciation and Spelling, N-grams, HMMs and Speech Recognition.
Section-B	Syntax: Word Classes and Part-of-Speech Tagging, Context-Free Grammars for English, Parsing with Context-Free Grammars, Features and Unification, Lexicalized and Probabilistic Parsing, Language and Complexity.
Section-C	Semantics: Representing Meaning, Semantic Analysis. Lexical Semantics, Word Sense Disambiguation and Information Retrieval
Section-D	Pragmatics: Discourse, Dialogue and Conversational Agents, Generation, Machine Translation Regular Expression Operators, The Porter Stemming Algorithm, C5 and C7 tag sets, Training HMMs: The Forward-Backward Algorithm.

Course Outcome:

CO1: Understand approaches to syntax and semantics in NLP.
CO2: Understand approaches to discourse, generation, dialogue and summarization within NLP.
CO3: Understand current methods for statistical approaches to machine translation.
CO4: Understand machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars, clustering and unsupervised methods.

Text Books

1. Akshar Bharati, Vineet Chaitanya, and Rajeev Sangal. NLP: A Paninian Perspective, Prentice Hall, New Delhi.

2. Speech and Language processing An introduction to Natural Language Processing, Computational Linguistics and speech Recognition by Daniel Jurafsky and James H. Martin (ISBN13: 978-0131873216) **References:**

1. Winograd, Language as a Cognitive Process, PEARSON Education.

Name of the Course	**Graph Theory and Optimization**		
Course Code	**MT-CSE-ES-04**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		

Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed to use in examinations.

Course Objectives:

- To develop analytical capability and to impart knowledge in graphs, linear programming problem and statistical methods and their applications in Engineering & Technology

Section	Course Content
Section-A	Basics of Graph Theory: Graphs - Data structures for graphs, Sub graphs, Operations on Graphs, Connectivity – Networks and the maximum flow - Minimum cut theorem - Trees - Spanning trees - Rooted trees – Matrix representation of graphs.
Section-B	Classes of Graphs: Eulerian graphs and Hamiltonian graphs - Standard theorems - Planar graphs -Euler's formula - Five colour theorem - Coloring of graphs - Chromatic number (vertex and edge) properties and examples - Directed graphs.
Section-C	Graph Algorithms: Computer Representation of graphs - Basic graph algorithms - Minimal spanning tree algorithm - Kruskal and Prim's algorithm - Shortest path algorithms - Dijsktra's algorithm - DFS and BFS algorithms.
Section-D	Optimization Techniques: Linear programming – Graphical methods – Simplex method (Artificial variables not included) – Transportation and assignment problems. Statistics: Tchebyshev's inequality – Maximum likelihood estimation – Correlation – Partial correlation – Multiple correlations.

Course Outcome:
CO1: Understand the various types of graph Algorithms and graph theory properties. **CO2:** distinguish the features of the various tree and matching algorithms
CO3: appreciate the applications of digraphs and graph flow.
CO4: Understand the linear programming principles and its conversion.

Text Books:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", PHI 1974.
2. Rao S.S., "Engineering Optimization: Theory and Practice", New Age International Pvt. Ltd., 3rd Edition 1998.

Name of the Course	**Quantum Computing**		
Course Code	**MT-CSE-ES-05**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		

Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C & D of the question paper and all the subparts of the questions in Section E.
Non-programmable calculators allowed to use in examinations.

Course Objectives:

- The objective of this course is to provide the students an introduction to quantum computation. Much of the background material related to the algebra of complex vector spaces and quantum mechanics is covered within the course.

Section	Course Content
Section-A	Introduction to Quantum Computation: Quantum bits, Bloch sphere representation of a qubit, multiple qubits. Background Mathematics and Physics: Hilber space, Probabilities and measurements, entanglement, density operators and correlation, basics of Quantum mechanics, Measurements in bases other than computational basis.
Section-B	Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum circuits. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.
Section-C	Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.
Section-D	Noise and error correction: Graph states and codes, Quantum error correction, Fault-tolerant computation.

Course Outcome:
CO1: The basic principles of quantum computing.
CO2: The fundamental differences between conventional computing and quantum computing.
CO3: Several basic quantum computing algorithms.
CO4: The classes of problems that can be expected to be solved well by quantum computers.

Text Books:

1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.

2. Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
3. Pittenger A. O., An Introduction to Quantum Computing Algorithms

LIST OF ELECTIVES

Semester-II

Name of the Course	**Data Warehousing and Data Mining**		
Course Code	**MT-CSE-ES-07**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		

Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Conceptual understanding of Data cleaning, analysis and visualization.
- Data mining techniques.
- Web mining and Spatial mining.

Section	Course Content
Section-A	Introduction: DSS, Data warehouse Architecture, Data Staging & ETL, Multidimensional Model, Meta data, Accessing data warehouse, ROLAP, MOLAP, HOLAP System Lifecycle: Risk factors, Top-down, Bottom-up, Data mart design phases, Methodological framework, Testing data marts, Data Sources: Inspecting and normalizing schemata, Integration problems, Integration phases, Mapping, User Requirements & Conceptual Modelling: Glossary based requirements analysis, Goal-oriented requirements analysis, Dimensional Fact Model, Advanced modelling, Events and Aggregation, Time, Formalizing the dimensional fact model
Section-B	Logical Modelling & Design: MOLAP, HOLAP & ROLAP systems, Views, Temporal scenarios, Fact schemata to star schemata, View materialization, View Fragmentation, Populating - reconciled databases, dimension tables, fact tables & materialized views, Cleansing data Data Warehouse Components: Overall architecture, database, Sourcing, acquisition, clean-up and transformation tools, Metadata, Access tools, Administration and management, Info delivery System Building a Data Warehouse: Considerations - business, design, technical & implementation, integrated solutions, Benefits
Section-C	Introduction: Data mining, Measuring effectiveness, Discovery Vs prediction, Over fitting, Comparing the technologies, Decision trees, where to use them,

	General idea, how do they work, Strengths and weaknesses. Techniques and Algorithms: Neural networks - uses, making predictions, different kinds, Kohonen feature map, their working, Nearest Neighbour& Clustering – uses, predictions and differences, their working, Genetic Algorithms – uses, cost minimization, cooperative strategies, their working, Rule Induction – uses, evaluation of rules, rules Vs decision trees, their working, Using the right technique, Data mining & business process
Section-D	Cluster Analysis- Outlier, Cluster Vs Classification, Clustering Issues, impact of Outliers on clustering, clustering problems, Clustering Approaches. Association Rules: Introduction, Basic concepts, Association Rule Algorithms-A priori AND Mining frequent item sets with and without candidate generation. Web Mining: Introduction, Web data, Web Knowledge Mining Taxonomy, Web Content mining, Web Usage Mining Research, Ontology based web mining Research, Web mining Applications.

Course Outcome:

CO1: Design a data mart or data warehouse for any organization
CO2: Develop skills to write queries using DMQL
CO3: Extract knowledge using data mining techniques
CO4: Adapt to new data mining tools.

Text Books:

1. Data Mining Concepts and Techniques-Jaiwei Han Micheline Kamber,2/e, Morgan Kaufmann, 2006.

Reference Book:

1. Introduction to Data Mining, Adriaan, Addison Wesley Publication.
2. Data Mining Techniques, A.K.Pujari, University Press.

Name of the Course	**Human Computer Interaction**		
Course Code	**MT-CSE-ES-08**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Understanding how to develop high-quality user interfaces for interactive systems
- Study of Development process
- Understand different interaction styles.
- Address various Design issues.

Section	**Course Content**
Section-A	Managing Design Processes: Introduction, Organizational Design to support Usability, The four pillars of Design, Development Methodologies, Ethnographic Observation, Participatory Design, Scenario Development, Social Impact statement for Early Design Review, Legal Issues.
Section-B	Evaluating Interface Designs**:** Introduction, Expert Reviews, Usability Testing and Laboratories, Survey Instruments, Acceptance Tests, Evaluation during Active use, Controlled Psychological Oriented Experiments. Direct Manipulation and Virtual Environments: Introduction, Examples of Direct Manipulation, Discussion of Direct Manipulation, 3D Interfaces, Tele operation, Virtual and Augmented Reality.
Section-C	Menu Selection, Form fillin, and Dialog Boxes: Introduction, Task-related Menu Organization, Single Menu, Combination of Multiple Menus, Content Organization, Fast movement through Menus, Data entry with Menus: Form filling, Dialog boxes and Alternatives, Audio Menus and Menus for small Display Command and Natural Languages: Introduction, Command-Organization Functionality, Strategies and Structure, Naming and Abbreviations, Natural Language in Computing

	Interaction Devices: Introduction, Keyboards and Keypads, Pointing Devices, Speech and Auditory Interfaces, Displays- Small and Large.
Section-D	Quality of Service: Introduction, Models of Response Time Impacts, Expectations and Attitudes, User Productivity, Variability in Response Time, Frustrating Experiences. Balancing Function and Fashion: Introduction, Error Messages, Non anthropomorphic Design, Display Design, Webpage Design, Window Design, Colour. User Documentation and Online Help: Introduction, Online versus Paper Documentation, Reading from Paper versus from Displays, Shaping the content of the Documentation, Accessing the Documentation, Online Tutorials and Animated Demonstrations, Online CommSectionies for User Assistance, The Development Process Information Search: Introduction, Searching in Textual Documents and Database Querying, Multimedia Document Searches, Advanced filtering and Search Interface.

Course Outcomes:

CO1: Apply an interactive design process and universal design principles to designing HCI systems.

CO2: Describe and use HCI design principles, standards and guidelines.

CO3: Analyze and identify user models, user support, socio-organizational issues, and stakeholder requirements of HCI systems.

CO4: design high-quality user interfaces for interactive systems

Text Books:

1. Alan Dix, Janet Finlay, Human computer Interaction, 3rd Edition, Pearson Education.

Reference Books:

1. The Encyclopedia of Human Computer Interaction, 2nd edition, by Interaction Design foundation.

Name of the Course	**Pattern Recognition Techniques**		
Course Code	**MT-CSE-ES-09**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To learn pattern recognition fundamentals, techniques, trends and applications.
- Pattern features and Statistical techniques.
- Feature extraction techniques and advances in the field.
- Syntactic Pattern Recognition.

Section	**Course Content**
Section-A	Pattern recognition introduction, pattern recognition systems, decision cycle, learning and adaptation: Supervised learning, unsupervised learning, reinforcement learning. Pattern recognition, Classification and Description—Patterns and feature Extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches
Section-B	Statistical pattern recognition: Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches. Introduction—Discrete and binary Classification problems—Techniques to directly Obtain linear Classifiers Formulation of Unsupervised Learning Problems—Clustering for unsupervised learning and classification.
Section-C	Syntactic pattern recognition: Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars–Graphical Approaches to syntactic pattern recognition—Learning via grammatical inference.
Section-D	Neural pattern recognition: Introduction to Neural networks—Feed forward Networks and training by Back Propagation—Content Addressable Memory Approaches and Unsupervised Learning in Neural PR.

Course Outcomes:

CO1: Explain and define concepts of pattern recognition.

CO2: Explain and distinguish procedures, methods and algorithms related to pattern recognition.

CO3: Apply methods from the pattern recognition for new complex applications.
CO4: Analyze and breakdown problem related to the complex pattern recognition system.

Text Books:

1. Robert Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John wiley & sons, Inc,1992.
2. Duda R.O., P.E.Hart& D.G Stork, "Pattern Classification", 2nd Edition, J. Wiley Inc 2001.

Reference Books:

1. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Pvt. Ltd, New Delhi, 1996.
2. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press, 1995.

Name of the Course	**Soft Computing**		
Course Code	**MT-CSE-ES-10**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- The course aims at providing knowledge of soft computing concepts and introducing the idea of neural networks, fuzzy logic and use of genetic algorithms.
- At the end of this course, students should be able to analyze the implementation of neural networks, implementation of genetic algorithms in various Optimization problems and use of Fuzzy Logic.

Section	**Course Content**
Section-A	Intelligent Agents: Agents Behaviour and Environments, Structure of Agents, Planning Problem, Planning with state Space Search, Partial order Planning, GRAPHPLAN, Planning in logic, planning in non-deterministic domains, hierarchical task planning, Multi agent planning, execution.
Section-B	Probabilistic Reasoning Fuzzy Logic: Knowledge representation under uncertainty, Bayesian theorem, Bayesian Networks, Dumpster Shafer theory, Representing vagueness, Fuzzy sets, operation on fuzzy sets, reasoning with fuzzy logic, Fuzzy Automata, Fuzzy Control methods, Fuzzy decision making, inference in temporal models, Hidden Markov Models, Kalman Filters.

Section-C	Neural Networks: Basic concepts, Single layer perception, Multilayer Perception, Supervised and Unsupervised learning – Back propagation networks - Kohnen'sself organizing networks - Hopfield network. Introduction to Artificial Neural Systems - Perception - Representation - Linear separability - Learning – Training algorithm -Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing
Section-D	Generic Algorithms: Evolutionary computation. Survival of the Fittest - Fitness
	Computations - Cross over – Mutation, Reproduction - Rank method - Rank space method.

Course Outcomes:

CO1: Understand soft computing techniques and their role in problem solving.

CO2: Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.

CO3: Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic.

CO4: To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations.

CO5: Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications

Text Books:

1. Stuart J.Russel, Norvig: AI: A Modern Approach, Pearson Education, and Latest Edition.
2. Michael Negnevitsky: Artificial Intelligence: A Guide to Intelligent Systems, 2/E, Addison-Wesley.

Reference Books:

1. James Freeman A. and David Skapura M: Neural Networks - Algorithms, Applications & Programming Techniques Addison Wesley.
2. YegnanarayanaB.: Artificial Neural Networks, Prentice Hall of India Private Ltd., New Delhi.
3. Hagan, M.T., Demuth, Mark Beale: Neural Network Design By Cengage Learning.
4. Goldberg, David E.: Genetic algorithms in search, optimization and machine learning, Latest Edition, Addison Wesley.

LIST OF ELECTIVES

Semester-III

Name of the Course	**VLSI Design**		
Course Code	**MT-CSE-ES-11**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- Introduction of architecture and design concepts underlying modern complex VLSIs and system-on-chips.
- Study of core VLSI architecture concepts.
- Analyzing design for testability.

Section	**Course Content**
Section-A	Introduction: Overview of VLSI design Methodologies, VLSI Design flow, Design Hierarchy, Concept of Regularity, Modularity, and Locality, VLSI design styles. Fabrication of MOSFETs: Fabrication Process flow: basic steps, Fabrication of NMOS Transistor, the CMOS n-Well Process, Layout Design Rules, Full- Custom mask Layout design, CMOS Inverter Layout Design. MOS Transistor: The MOS Structure, Structure and operation of MOSFET, The MOS System under External Bias, The Threshold Voltage, MOSFET Current–Voltage Characteristics, Channel Length Modulation, Substrate Bias Effect, MOSFET Scaling and Small Geometry Effects, Short Channel Effects, Narrow Channel Effects, Limitation Imposed by Small Device Geometries , MOSFET Capacitances.

Section-B	MOS Inverters: Static Characteristics: CMOS Inverters, Circuit operation, Voltage transfer characteristics of CMOS Inverter, Calculation of VIL, Calculation of VIH, Calculation of inverter threshold voltage, Noise Margin. MOS Inverters: Switching Characteristics: Delay Time Definitions, Calculation of Delay Times, Inverter Design with delay constraints, Estimation of Interconnect Parasitic, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters.
Section-C	Combinational MOS Logic Circuits: CMOS Logic Circuits, Layout of simple
	logic gates, Complex Logic Circuits, Layout of Complex Logic Gates, AOI and OAI Gates, CMOS Transmission Gates (pass gates), Complementary Pass Transistor Logic. Sequential MOS Logic Circuits: Behaviour of Bistable element, SR Latch Circuits, Clocked Latch and Flip flop Circuits, CMOS D-Latch and Edge Triggered Flip flop, Clocked JK Latch, Master slave Flip flop.
Section-D	Semiconductor Memories: Dynamic Random Access Memory, DRAM Configuration, Historical Evaluation of DRAM Cell, DRAM Cell Types, operation of one transistor DRAM Cell, DRAM Operation Modes, Static Random Access Memory, Full custom SRAM Cell, CMOS SRAM Design Strategy, Operation of SRAM, Flash Memory NOR Flash Memory Cell, NAND Flash Memory Cell, Flash Memory Circuit. Design for Testability: Fault Types and Models, Ad Hoc Testable Design Techniques, Scan –based Techniques, Built-In Self Test Techniques.

Course Outcomes:

CO1: Identify the various IC fabrication methods.
CO2: Express the Layout of simple MOS circuit using Lambda based design rules. **CO3:** Apply the Lambda based design rules for subsystem design **CO4:** Differentiate various FPGA architectures.
CO5: Design an application using Verilog HDL.

Text Book:

1. S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis and Design, Third Edition, MH, 2002 **Reference Book:**
2. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design: A Systems Perspective, Fourth Edition.

Name of the Course	**Machine Learning for Big Data**		
Course Code	**MT-CSE-ES-12**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To understand big data and a look at the dominant software systems and algorithms for coping with Big Data.
- To introduce machine learning and the analysis of large data sets using distributed computation and storage infrastructure.

Section	Course Content
Section-A	Understanding big data landscape, Getting Started with Big Data Analytics, Analyzing Big Data in Context, Getting Value from Predictive Analytics and Big Data.
Section-B	Humanizing Big Data Analytics, Publishing Data and Analytics to Cloud Service, evaluating tools and techniques.
Section-C	Introduction: Definition, Probability Theory, Basic Algorithm Density Estimation: Limit Theorems, Parzen Window, Estimation, Sampling
Section-D	Optimization: Preliminaries, Unconstrained Smooth Convex Minimization, constraint, stochastic, non convex optimizations, online learning and boosting. Conditional densities: regression, multiclass classification, CRF, Hidden Markov Models

Course Outcomes:

CO1: Identify the characteristics of datasets and compare the trivial data and big data for various applications.

CO2: Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration

CO3: Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.

CO4: Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.

CO5: Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and mapreduce.

Text Books:

1. Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan, Cambridge university press, 2008
2. Big Data analytics for DUMMIES by Michael Wessler, OCP & CISSP, John Wiley & Sons

Reference Books:

1. Machine Learning: A Probabilistic Perspective By Kevin P. Murphy, MIT Press.
2. Foundation of machine learning by By Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, MIT Press
3. Introduction To Machine Learning by Nils J. Nilsson, Robotics Laboratory
4. Big Data Now by by O'Reilly Media, Inc. 2013.

Name of the Course	**Advanced Parallel Programming**		
Course Code	**MT-CSE-ES-13**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:

The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:

Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To present the main concept behind parallel programming models and their implementation.
- To analyzes productive programming environments and their efficient implementation.
- To describe the tools required to understand the behaviour of parallel applications when executed on current supercomputing architectures.

Section	Course Content
Section-A	Introduction: Why Parallel Architecture, Convergence of Parallel Architectures, Fundamental Design Issues Parallel Programs**:** introduction, The Parallelization Process, Parallelization of an Example Program
Section-B	Programming for Performance: Partitioning for Performance, Data Access and Communication in a Multi-Memory System, Performance Factors, The Parallel Application Case Studies, Implications for Programming Models Workload-Driven Evaluation: Scaling Workloads and Machines, Evaluating a Real Machine, Evaluating an Architectural Idea or Trade off

Section-C	Shared Memory Multiprocessors: Introduction, Cache Coherence, Memory Consistency, Realizing Programming Models, Physical DMA, Comparison of Communication Performance, Synchronization Directory-based Cache Coherence: Scalable Cache Coherence, Overview of Directory-Based Approaches, Assessing Directory Protocols and Tradeoffs, Design Challenges for Directory Protocols, Memory-based Directory Protocols, Cache-based Directory Protocols, Synchronization, Advanced Topics
Section-D	Hardware-Software Tradeoffs: Introduction, Relaxed Memory Consistency Models, Overcoming Capacity Limitations, Reducing Hardware Cost Advanced Topics
	Interconnection Network Design: Introduction, Organizational Structure, Interconnection Topologies, Evaluating Design Trade-offs in Network Topology, Routing, Switch Design, Flow Control, Case Studies.

Course Outcomes :

CO1: will be familiar with the concepts of parallel processing and understand the particular problems arising in programming of parallel machines.

CO2: will be familiar with the parallel computing models and the "parallel-way of thinking" required in the design of parallel algorithms.

CO3: will be able to apply the basic algorithmic techniques and design algorithms in a shared memory as well as a distributed memory environment;

CO4: will understand and be able to apply basic parallel programming principles in a shared/ distributed memory environment

Text Books:

1. Parallel Computer Architecture: A Hardware / Software Approach by David Culler, Jaswinder Pal Singh and with Anoop Gupta, Morgan Kaufmann Publishers

Reference Books:

1. Introduction to Parallel Computing by Ted G. Lewis and H. El-Rewini, Prentice-Hall, 1992.
2. Designing and Building Parallel Programs by Ian Foster , Addison Wesley, 1995
3. Highly Parallel Computing by G.S. Almasi and A. Gottlieb, Benjamin Cummings, 1994.
4. Introduction to Parallel Processing by P. Ravi Prakash, M. Sasikumar, Dinesh Shikhare, PHI Learning Pvt. Ltd
5. Big Data Now by O'Reilly Media, Inc. 2013.

Name of the Course	**Distributed Database Management System**		
Course Code	**MT-CSE-ES-14**	**Credits-4**	L-3, T-1, P-0
Total Lectures	52 (1 Hr Each) (L=39, T=13 for each semester)		
Semester End Examination	Max Marks: 100	Min. Pass Marks: 40	Max. Time: 3 Hrs.
Internal Assessment: (based on sessional tests 50%, Tutorials/Assignments 30%, Quiz/Seminar 10%, Attendance 10%)			Max Marks: 50

Instructions

For Paper Setters:
The question paper will consist of five Sections A, B, C, D & E. Section E will be compulsory, it will consist of a single question with 10-20 subparts of short answer type, which will cover the entire syllabus and will carry 20% of the total marks of the semester end examination for the course. Section A, B, C & D will have two questions from the respective sections of the syllabus and each question will carry 20% of the total marks of the semester end examination for the course.

For Candidates:
Candidates are required to attempt five questions in all selecting one question from each of the Sections A, B, C & D of the question paper and all the subparts of the questions in Section E. Use of non-programmable calculators is allowed.

Course Objectives:

- To offer a good understanding of distributed database systems concepts.
- To prepare the student to be in a position to use and design databases for different applications.
- To make students familiar with the design and implementation issues of distributed database management system

Section	Course Content

Section-A	Introduction: Distributed data processing, Fundamentals of distributed database system(transparent management of distributed and replicated data, reliability, improved performance, system expansion), Disadvantages of distribute DBMS (complexity, cost, directory management, concurrency control, deadlock management, reliability, OS support, heterogeneous databases, relationship)Relational Data Base Management System: Basic concepts, Data Modeling for a database, Records and files, Abstraction and Data Integration, Three tier architecture proposal for DBMS, Components of a DBMS, Advantages and disadvantages of DBMS, Data Models, Data associations model. Normalization: Dependency structures, Normal forms.
Section-B	Distributed DBMS Architecture: Architectural models for distributed DBMS (Autonomy, distribution, heterogeneity, architectural alternatives), Client/ server systems, Peer- to peer distributed systems. Allocation: problem, information requirement, allocation model, solution methods. Distributed database design: design strategies (top- down design and bottom up design process), design issues(reasons for fragmentation, alternatives, degree and correctness rules of fragmentation, allocation alternatives, information requirement) Fragmentation: horizontal, vertical, hybrid fragmentation.
Section-C	Controlling Concurrency: terminology, Multi-transaction processing systems, centralized DBE concurrency control, concurrency control in distributed database systems Deadlock handling: definition, deadlocks in centralized systems, deadlocks in distributed in distributed system, distributed deadlock detection Replication control: replication control scenarios, replication control algorithms
Section-D	Failure and commit protocols: terminology, Undo/redo and database recovery, Transaction states revised, database recovery, other types of database recovery, recovery-based Redo/ Undo processes, complete recovery algorithm, distributed commit protocols DDBE security: cryptography, securing communications, securing data architectural issues.

Course Outcomes:

CO1: Understand distributed database systems architecture and design.

CO2: Be able to apply methods and techniques for distributed query processing and CO3: optimisation.

CO3: Understand the broad concepts of distributed transaction process.

CO4: Understand the basic concepts of recovery algorithms and data security.

Text Books:

1. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw Hill.
2. M. Tamer Ozsu, PatricsValduriez "Principles of Distributed Database Systems" 3rd edition, Springer, Pearson Education.

Reference Books:

1. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Wiley India Pvt. Ltd.
2. Rajib Mall, "Real Time Systems: Theory and Practice", Pearson Education India.
3. Distributed Systems - An Algorithmic Approach by Sukumar Ghosh, Chapman and Hall/CRC.
4. Distributed Algorithms: Principles, Algorithms, and Systems by D. Kshemkalyani and M. Singhal, Cambridge University Press.
5. Distributed Systems: Concepts and Design by G. Coulouris, J. Dollimore, and T. Kind berg, Pearson Education.
6. Distributed Systems: Principles and Paradigms by A. Tanenbaum and Maarten van Steen, Prentice Hall of India.