UNIVERSITY OF JAMMU

(NAAC ACCREDITED A + GRADE UNIVERSITY)
Baba Sahib Ambedkar Road, Jammu-180006 (J&K)

NOTIFICATION

(23/Sept/Adp/ 85)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Competent Bodies, has been pleased to authorize the adoption of the revised Syllabi and Courses of Studies of **Master of Technology (M.Tech.) in Computer Science and Engineering for Semester I to IV** under Credit Based System (as given in the Annexure) for the Examinations to be held in the years indicated against each Semester as under:-

Branch	Semester	For the Examination to be held in the years
Computer Science & Engineering	**Semester-I**	**December 2023, 2024, 2025**
	Semester-II	**May 2024, 2025, 2026**
	Semester-III	**December 2024, 2025, 2026**
	Semester-IV	**May 2025, 2026, 2027**

The Syllabi of the course are available on the University Website: www.jammuuniversity.ac.in.

Sd/-
DEAN ACADEMIC AFFAIRS

No. F.Acd/III/23/ 10040-10046
Dated: 14 **/09/2023**
Copy for information & necessary action to:-

1. Dean Faculty of Engineering
2. Principal, GCET
3. C.A to the Controller of Examinations
4. Joint/Assistant Registrar (Exams Prof./Eval Prof./Confidential)
5. Incharge University Website

14/Sept/23
Assistant Registrar (Academic)
14/9/23 14/09/23

ANNEXURE-I

UNIVERSITY OF JAMMU, JAMMU
Course Scheme

M. Tech 1st Semester Computer Science & Engineering
For Examinations to be held in the December 2023, 2024, 2025

M. Tech CSE – Semester 1st

Contract Hours/Week: 23

S. No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks		% Change
			L	T	P		Internal	External	
1	MHUM101	Research Methodology	3	1	-	4	25	75	15%
2	MCSE101	Advanced Data Structures and Algorithms	3	1	-	4	25	75	20%
3	MCSE102	Advanced Computer Networks	3	1	-	4	25	75	20%
4	MCSE103	Distributed Systems	3	1	-	4	25	75	20%
5	MOOC300	NPTEL / SWAYAM / MOOC	3		-	3	100	-	100%
6	MCSE111	Advanced Data Structures and Algorithms Lab	-	-	2	1	50	-	40%
7	MCSE112	Advanced Computer Networks Lab	-	-	2	1	50	-	20%
Total Credits and Marks						**21**	**300**	**300**	

ANNEXURE-II

UNIVERSITY OF JAMMU, JAMMU
Course Scheme

M. Tech 2nd Semester Computer Science & Engineering
For Examinations to be held in the May 2024, 2025, 2026

M. Tech CSE - Semester II

Contract Hours/Week: 28

S.No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks		% Change
			L	T	P		Internal	External	
1.	MCSE201	Advance Machine Learning	3	1	-	4	25	75	100%
2.	MCSE202	Object Oriented Modelling & Design	3	1	-	4	25	75	100%
3.	MCSE203	Information and Storage Management	3	1	-	4	25	75	100%
4.	MCSE2A1	**Elective A** Cloud Computing	3	1	-	4	25	75	30%
	MECE201	IOT and its Industrial Applications							100%
5.	MCSE2B1	**Elective B** Software Quality Assurance and Testing	3	1	-	4	25	75	20%
	MCSE2B2	Mobile Computing							100%
6.	MCSE211	Advance Machine Learning lab	-	-	2	1	50	-	100%
7.	MCSE2AA	**Elective A Lab** Cloud Computing Lab			2	1	50	-	20%
	MECE211	IOT and its Industrial Applications Lab							100%
8.	MCSE212	Seminar	-	-	4	2	100	-	0%
Total Credits and Marks						**24**	**325**	**375**	

ANNEXURE-III

UNIVERSITY OF JAMMU, JAMMU
Course Scheme

M. Tech 3rd Semester Computer Science & Engineering

For Examinations to be held in the December 2024, 2025, 2026

M. Tech CSE - Semester III

Contract Hours: 26

S.No	Subject Code	Subject	Teaching Hours/ Week			Credits	Marks		% Change
			L	T	P		Internal	External	
1	MCSE3C1	**Elective C** Big Data Analytics	3	1	-	4	25	75	100%
	MCSE3C2	Digital Image Processing							30%
2	MCSE3D1	**Elective D** Cyber Security and Digital Forensics	3	1	-	4	25	75	40%
	MCSE3D2	Data Science							100%
3	MCSE3CA	**Elective C Lab** Big Data Analytics Lab	-		2	1	50	-	100%
	MCSE3CB	Digital Image Processing Lab							100%
4	MCSE3DA	**Elective D Lab** Cyber Security and Digital Forensics Lab	-		2	1	50	-	40%
	MCSE3DB	Data Science Lab							100%
5	MCSE311	Dissertation – I			14	7	150	-	0%
Total Credits and Marks						**17**	**300**	**150**	

Approved

ANNEXURE-IV

UNIVERSITY OF JAMMU, JAMMU
Course Scheme

M. Tech 4th Semester Computer Science & Engineering
For Examinations to be held in the May 2025, 2026, 2027

M. Tech CSE - Semester IV

Contract Hours/Week: 36

S.No	Subject Code	Subject	Teaching Hours/ Week			Credit	Marks		Percentage Change
			L	T	P		Internal	External	
1	MCSE411	**Dissertation-II** (Students have to submit the final project report at the end of the semester which will be evaluated followed by a seminar, presentation and viva -voce examination.)	-	-	36	18	300	150	0%
Total Credits						**18**	**450**		

For Examinations to be held in the December 2023, 2024, 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Research Methodology
Course No.: MHUM101
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: Research Methodology is a hands-on course designed to impart education in the foundational methods and techniques of academic research in social sciences and business management context. Research scholars would examine and be practically exposed to the main components of a research framework i.e. problem definition, research design, data collection,ethical issues in research, report writing, and presentation. Once equipped with this knowledge, participants would be well- placed to conduct disciplined research under supervision in an area of their choosing. In addition to their application in an academic setting, many of the methodologies discussed in this course would be similar to those deployed in professional research environments.

Course Outcomes: By the end of the course students shall be able to:

CO 1	To develop understanding of the basic framework of research process by exploring various research designs and techniques.
CO 2	To identify various data collection, processing and analysis methods.
CO 3	To develop an understanding of the ethical dimensions of conducting applied research.
CO 4	To develop and practice the skills necessary to conduct, review and publish research.

Detailed Syllabus

Unit 1: Research Methodology: Introduction, Objectives of Research, Significance of Research, Research Methods versus Methodology, Types of Research - Exploratory Research, Descriptive Research, Casual Research, Research Process, Defining a Research Problem, Techniques involved in defining a Problem. **(11hrs)**

UNIT 2: Research Design: Need for Research Design, Features of Good Design, Different Research Designs, , Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sample size determination, Questionnaire Design and Testing, Measurement and Scaling, Scaling Techniques. **(12hrs)**

UNIT 3: Methods of Data Collection and presentation: Methods of Data Collection, Collection of Primary and Secondary Data, Selection of appropriate method, Data Processing Operations, Diagrammatic and graphical representation of data with Pie chart, Bar diagram, Line chart, Histogram, Frequency Polygon, Ogive curves and Spreadsheets. **(14hrs)**

Unit 4: Statistical tools: : Measure of central tendencies – Arithmetic Mean (For individual observation, Discrete series & continuous series) Median, Mode, Quartiles, Deciles and Percentiles; Measure of Dispersion- Range, Quartile Deviation, Standard Deviation, Variance and Coefficient of Variance. **(12hrs)**

UNIT 5: Techniques of Hypotheses: Hypotheses meaning and basics concepts, Flow diagram, Power of hypothesis test, Types of hypothesis, Limitations of tests of hypothesis, Chi-square Test, Correlation and Regression, Conversion of Chi to Phi, Caution in using Chi-square test. **(11hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabusbased on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

1. C.R. Kothari, Wiley Eastern ,Research Methodology,
2. Willkinson K.P, L Bhandarkar ,Formulation of Hypothesis, Himalaya Publication, Bombay.
3. John W Best and V. Kahn ,Research in Education , PHI Publication
4. A. Lemley , Intellectual Property in New Technological Age , 2016.
5. Booth,Colomb andWilliams,The Craft of Research,University of Chicago Press,Chicago & London,Second edition, 2003.
6. John W. Creswell. Research Design, Sage Publications, New Delhi, Third Edition, 2009.

For Examinations to be held in the December 2023, 2024, 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Advanced Data Structures and Algorithm
Course No.: MCSE101
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: This course aims to provide the advanced methods of designing and analyzing algorithms and ability to choose appropriate algorithms and use it for a specific problem. It familiarize students with design paradigms and advanced data structures used to solve advanced algorithmic problems and to understand different classes of problems concerning their computation difficulties.

Course Outcomes: By the end of the course student shall be able to:

CO1	To gain knowledge about the Algorithm Design techniques, Advanced Data Structures and mathematical tools to analyze algorithms for effective problem solving in computing.
CO2	Apply various algorithmic design paradigms and employ advanced Data Structures to model a variety of real-world problems.
CO3	To analyze the complexity and performance of different algorithms
CO4	To Understand the limits of efficient computation through the concepts of P, NP and NP-Complete problems and get familiar with main thrust of work in algorithm sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

Detailed Syllabus

UNIT 1 : Complexity Analysis: Growth Rate of Functions, Asymptotic Notation, Asymptotic Analysis, Analyzing Algorithm Control Structures, Standard Notations and Common Functions; Recurrences: The Substitution Method,Iteration method, Master method; Amortized Analysis: Aggregate, Accounting and Potential Method **(5 hrs)**

UNIT 2: Advanced Trees :AVL Trees: Balance Factor, Insertion in AVL Trees;; Splay Trees ; Red-Black trees: Properties of Red-Black Trees, Rotations, Insertion, Deletion; B-Trees: Basic operations on B-Trees, Inserting and Deleting a key from a B-Tree. **(12 hrs)**

UNIT 3: Binomial and Fibonacci Heaps: Binomial Heaps:Representation ,Properties and its operations ; Fibonacci Heaps : Structure, Potential function, Merge-heap operations: Insert, Union, decreasing a key and deleting a node, Finding and Deleting the minimum ,Bounding the maximum degree. **(07 hrs)**

UNIT 4 : Graphs and related Algorithms: Depth and Breadth first Traversals, Topological Sort, Minimum Spanning Trees: Kruskal,Prim; Single Source Shortest Paths:Dijkstra's algorithm, Bellman Ford algorithm, Single source Shortest paths in Directed Acyclic Graphs ; All-Pairs Shortest Paths:Shortest Paths:Matrix Multiplication, Floyd-Warshall's Algorithm. **(12 hrs)**

UNIT 5: Algorithm Design Techniques: Dynamic Programming:Principle of Optimality, Elements of Dynamic Programming, Matrix-Chain Multiplication ,Longest Common Subsequence; Greedy Algorithms: Characteristics and features of problems solved by Greedy Algorithms, Basic Structure of Greedy Strategy, An Activity Selection Problem, Huffman Codes. **(10 hrs)**

UNIT 6 : NP Completeness, Approximation and Randomized Algorithms: P, NP and NP-Complete and NP Hard complexity classes, NP-Completeness and Reducibility; Approximation algorithm: Introduction, Performance ratio, Approximation algorithms for Vertex cover and Travelling Salesman problem; Randomized Algorithm: Las Vegas and Monte Carlo algorithms, Randomized Quick Sort, Randomized Minimum cut algorithm **(10 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours.The candidates shall have to attempt any 5questions.

Suggested Books:

1. ThomasH.Cormen,CharlesE.Leiserson,RonaldL.Rivest,CliffordStein,Introduction to Algorithms, MIT Press, 2022
2. Peter Brass , Advanced Data Structures , Cambridge University Press.
3. Ellis Horowitz and SartajSahni,Fundamentals of ComputerAlgorithms-(secondedition),UniversitiesPress
4. RobertSedgewickandKevinWayne,Algorithms,FourthEdition,PearsonEducation.
5. S.Sridhar,DesignandAnalysisofAlgorithms,FirstEdition,OxfordUniversityPress.2014
6. AlfredV.Aho,JohnE.Hopcroft,JeffreyD.Ullman,—DataStructuresandAlgorithms,PearsonEducation, Reprint2006.
7. Udit Agarwal , Algorithms Design and Analysis, Educational & Technical Publishers

For Examinations to be held in the December 2023, 2024, 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Advanced Computer Networks
Course No.: MCSE102
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course overview: This course introduces software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behaviour of an entire network.

Course Outcomes: By the end of the course students shall be able to:

CO1	To understand various types of routing & switching techniques and also understand various network architectures deployed in networking.
CO 2	Understand the concept of SDN basic paradigm, requirements and challenges
CO 3	Analyse the implications of shifting from traditional network architectures to SDN

Detailed Syllabus

UNIT 1:Packet Switching Network: Historical background, Network services and Internal operations, Packet Network Topology, Datagram and virtual circuit, Routing in Packet Networks, Shortest Path Routing, Traffic Management and QOS at packet level; Traffic management at flow level (Congestion control). **(08 hrs)**

UNIT 2: Advanced Network Architecture: Overview of ATM Networks ,IP forwarding Architecture, Overlay Models, MPLS, Integrated Services in Internet, RSVP, Differentiated Services, Realtime Transport Protocol. **(10hrs)**

UNiT 3 :Introducing SDN : SDN Origins and Evolution – Introduction – Why SDN?:Evolution of Switches and Control Planes: Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs,The Genesis of SDN , How SDN works ?:- SDN Architecture, Centralised and distributed Control planes, and Data Planes ,open flow switches, southbound and northbound protocols, Open daylight, Open flow , Alternatives definitions of SDN Methods,SDN Controllers. **(12hrs)**

UNIT 4: SDN in the Data Center: Abstract, Data Centre Definition, Data Center Demands, Tunnelling Technologies for the Data Centre, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations **(08 hrs)**

UNIT 5Network Topology and Topological Information Abstraction: Introduction, Network, Topology, Traditional Methods, LLDP, BGP-TE/LS, ALTO, I2RS Topology, SDN Applications: Reactive versus Proactive Applications, Analysing SDN Applications, Background on controllers, using Floodlight controller, Open Daylight Controller, Switch consideration, creating network virtualization tunnels, offloading flows in the data centres, Traffic Engineering for service providers. **(10hrs)**

UNIT 6 :SDN in Other Environments: Abstract, Consistent Policy configuration, Global Network View, Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, Optical Networks, SDN vs. P2P/Overlay Networks. Introduction to Network Function Virtualisation **(06 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

1 Communication Network by Alberto Leon Garcia and IndraWidjaja.
2 SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media
3 Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan
4 Kaufmann.

For Examinations to be held in the December 2023, 2024, 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Distributed Systems
Course No.: MCSE103
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: The course aims to provide an understanding of the principles on which the Internet and other distributed systems are based; their architecture, algorithms and how they meet the demands of contemporary distributed applications. The course covers the building blocks for a study of distributed systems, and addressing the characteristics and the challenges that must be addressed in their design: scalability, heterogeneity, security and failure handling being the most significant. This course also covers issues and solutions related to the design and the implementation of distributed applications.

Course Outcomes : By the end of the course students shall be able to:

CO 1	Learn issues related to clock Synchronization and the need for global state in distributed systems when designing, implementing, and debugging distributed systems
CO 2	Understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
CO 3	Compare replication schemes with respect to performance, availability, and consistency concerns

Detailed Syllabus

UNIT 1:Introduction: Definition , Relation to computer system components , Motivation , Relation to parallel systems , Message-passing systems versus shared memory systems ,Primitives for distributed communication ,Synchronous versus asynchronous executions , Design issues and challenges. A model of distributed computations: A distributed program , A model of distributed executions , Models of communication networks , Global state , Cuts , Past and future cones of an event , Models of process communications. Logical Time: A framework for a system of logical clocks , Scalar time , Vector time , Physical clock synchronization: NTP. **(10hrs)**

UNIT 2: Global state& Snapshots recording algorithms: Introduction to System model and definitions , Snapshot algorithms for FIFO channels, Variation of Chandy-Lamport algorithm, snapshot algorithms for non-FIFO channels, snapshots in casual delivery system, Monitoring global state, Necessary and sufficient conditions for consistent global snapshot, Finding consistent global snapshot in a distributed computation. **(08hrs)**

UNIT 3: Topology abstraction and overlays: Classification and basic concepts, complexity measures and metrics, Program structure, Elementary Graph algorithms, Maximal independent set (MIS), Connected dominating set, compact routing tables, Leader election. **(06 hrs)**

UNIT 4: Message ordering and Group Communication: Message ordering paradigms, Asynchronous execution with synchronous communication, synchronous program order on a asynchronous system, Group communication, Casual ordering(CO), Total order, Multicast: propagation trees for multicast algorithms, Fault tolerant group communication, Distributed multicast algorithm at network layer. **(08 hrs)**

UNIT 5: Distributed Mutex & Deadlock: Distributed mutual exclusion algorithms: Introduction , Preliminaries , Lamport's algorithm , Ricart-Agrawala algorithm. Deadlock detection in distributed systems: Introduction , System model ,Preliminaries , Models of deadlocks , Knapp's classification, Algorithms for the single resource model, the AND model and the OR model. **(08hrs)**

UNIT6: Recovery & Consensus: Check pointing and rollback recovery: Introduction, Background and definitions ,Issues in failure recovery ,Checkpoint-based recovery, Log-based rollback recovery, Coordinated check pointing algorithm ,Algorithm for asynchronous check pointing and recovery. Consensus and Agreement algorithms: Problem definition, Overview of results, Agreement in a failure–free system, Agreement in synchronous systems with failures. **(10hrs)**

UNIT 7: Authentication & Self stabilization: Authentication Introduction and basic definitions: protocols based on symmetric cryptosystems and asymmetric cryptosystems, password based authentication, authentication protocol failures Introduction to self-stabilization, Issues in designing various self-stabilizing algorithms, methodologies for designing self-stabilizing systems, self-stabilizing distributed spanning trees, Self-stabilization as a solution to fault tolerance. **(08hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

- Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
- Mukesh Singhal and Niranjan G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.
- Tanenbaum A.S., Van Steen M., —Distributed Systems: Principles and Paradigmsl, Pearson Education, 2007.
- Liu M.L., —Distributed Computing, Principles and Applicationsl, Pearson Education, 2004.
- Nancy A Lynch, —Distributed Algorithmsl, Morgan Kaufman Publishers, USA, 2003

For Examinations to be held in the December 2023, 2024, 2025

L	T	P	C	Theory (External)	Internal
3	-	-	3	-	100

Class: M. Tech 1st Semester
Branch: CSE
Course Title: NPTEL / SWAYAM
Course No.: MOOC300
Duration Exam: 3 HRS

The students shall register for a 12 week NPTEL/ SWAYAM course offered by IIT Madras ,out of the list of courses floated by SWAYAM around the time of commencement of the semester. However, the selected NPTEL course should not be similar to the regular courses offered as a part of the department curriculum. The choice of course needs to be duly endorsed by the Department Academic Committee.

The overall monitoring of the NPTEL course will be under the supervision of the teacher incharge of the department.

The NPTEL/SWAYAM certification course comprises of Assignments (25%) and Proctored Examination (Online examination MCQ's based =75%) conducted at the end of the semester by IIT Madras as per the schedule.

The marks obtained by the students in the NPTEL/SWAYAM certification course will be tabulated by the concerned department.

NOTE: - *In case the student does not pass the certification exam or remains absent in the proctored examination, no certificate will be given to the candidate by NPTEL and the student will be deemed to have failed in that course. The student will have to register again for the next semester NPTEL course and pass the examination along with a certificate.*

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For Examinations to be held in the December 2023, 2024, 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Advanced Data Structures and Algorithms Lab
Course No.: MCSE111

L	T	P	C	Internal
-	-	2	1	50

Course Overview: To learn and implement advanced Data Structures and various algorithmic design strategies for efficient problem solving

Course Outcomes: By the end of the course students shall be able to

CO1	To provide deeper insight on advanced Data Structures and Algorithm Design Strategies
CO2	To Implement various operations on advanced Data Structures
CO3	Apply various algorithmic design paradigms and employ advanced Data Structures to solve a variety of real world problems.

Suggested Lab Exercises

1. Implement AVL Trees
2. Implement Red Black Trees
3. Implement Spaly Trees
4. Implement B-Trees
5. Implement Binomial Heaps
6. Implement Fibonacci Heaps
7. Implement Kruskal's algorithm for Minimum Spanning Tree
8. Implement Prim's algorithm for Minimum Spanning Tree
9. Implement Dijkstra's algorithm for single source shortest path
10. Implement Bellman-Ford algorithm for single source shortest path
11. Implement Floyd- Warshall algorithm for all pair's shortest paths
12. Implement Matrix Chain Multiplication using Dynamic Programming
13. Implement Longest Common Subsequence using Dynamic Programming
14. Implement Activity Selection Problem using Greedy Strategy
15. Implement Huffman Codes using Greedy Strategy.
16. Implement any schema to find the optimal solution for the Travelling Salesman Problem and then solve the same instance using any approximation algorithm and determine the error in the approximation.

Note: Student has to implement at least 10 programs from above list

Laboratory work will be evaluated on Internal scheme with following components:
1) Lab. Work (Continuous Assessment) 70%
2) Viva-voce test 30%

For Examinations to be held in the December 2023, 2024 , 2025

Class: M. Tech 1st Semester
Branch: CSE
Course Title: Advanced Computer Networks Laboratory
Course No.: MCSE112

L	T	P	C	Internal
-	-	2	1	50

Course overview: To learn Advance Computer Network concepts and their relevance to an emerging paradigm in Computer Networking.

Course Outcomes: By the end of the course students shall be able to:

CO1	Identify and understand the various design issues of internetworking and routing protocols.
CO2	Understand the concept of network virtualization framework.
CO3	Understand the working principles and design issues of various SDN controllers and protocols.

Laboratory work:
1. Use network Simulator (NS2/NS3/NetSim/Omnet etc.) and Network Emulator GNS3
2. Experiments related to routing protocols
3. To understand the concepts of networking in virtual machines
4. Use of Network Tools e.g. tools for file transfer, network monitoring etc.
4. Case study on SDN controllers
5. Case study on Building SDN Framework like Juniper SDN Framework, Open Daylight Controller/Frame work
6. Explore current research trends in computer networks.

Note: Laboratory work will be evaluated on Internal scheme with following components:
1) Lab. Work (Continuous Assessment) 70%
2) Viva-voce test 30%

FOR EXAMINATIONS TO BE HELD IN THE MAY 2024, 2025, 2026

Class: M. Tech 2nd Semester
Branch: CSE
Course Title: Advanced Machine Learning
Course No.: MCSE201
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview : This course provides an advanced level of understanding to machine learning and statistical pattern recognition. It offers some of the most cost-effective approaches to automated knowledge acquisition in emerging data-rich disciplines and focuses on the theoretical understanding of these methods, as well as their computational implications..

Course Outcomes: By the end of the course students shall be able to:

CO1	Demonstrate in-depth knowledge of methods and theories in the field of machine learning.
CO2	Demonstrate the use Bayesian perspective on machine learning, Artificial neural networks, back propagation algorithm
CO3	Assess the learning algorithms modelled after biological evolution, including genetic algorithms and genetic programming.
CO4	To demonstrate the ability to critically evaluate and compare different learning models and learning algorithms.

Detailed Syllabus

Unit 1 Introduction: Well-Posed learning problems, Basic concepts, Designing a learning system, Issues in machine learning. Types of machine learning: Learning associations, Supervised learning (Classification and Regression Trees, Support vector machines), Unsupervised learning (Clustering), Instance-based learning (K-nearest Neighbor, Locally weighted regression, Radial Basis Function), Reinforcement learning (Learning Task, Qlearning, Value function approximation, Temporal difference learning). **(12 hrs)**

Unit 2 Decision Tree Learning: Decision tree representation, appropriate problems for decision tree learning, Univariate Trees (Classification and Regression), Multivariate Trees, Basic Decision Tree Learning algorithms, Hypothesis space search in decision tree learning, Inductive bias in decision tree learning, Issues in decision tree learning. **(10 hrs)**

Unit 3 Bayesian Learning: Bayes theorem and concept learning, Bayes optimal classifier, Gibbs algorithms, Naive Bayes Classifier, Bayesian belief networks, The EM algorithm. **(8 hrs)**

Unit 4 Artificial Neural Network: Neural network representation, Neural Networks as a paradigm for parallel processing, Linear discrimination, Pairwise separation, Gradient Descent, Logistic discrimination, Perceptron, Training a perceptron, Multilayer perceptron, Back propagation Algorithm. Recurrent Networks, Dynamically modifying network structure. **(12 hrs)**

Unit 5 Genetic Algorithms: Basic concepts, Hypothesis space search, Genetic programming, Models of evolution and learning, Parallelizing Genetic Algorithms. Inductive and Analytical Learning: Learning rule sets, Comparison between inductive and analytical learning, Analytical learning with perfect domain theories: Prolog-EBG. Inductive-Analytical approaches to learning, Using prior knowledge to initialize hypothesis (KBANN Algorithm), to alter search objective (Tangent Prop and EBNN Algorithm), to augment search operators (FOCL Algorithm). **(12 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Recommended Books

1. Mitchell T.M., Machine Learning, McGraw Hill (1997).
2. Alpaydin E., Introduction to Machine Learning, MIT Press (2010).
3. Bishop C., Pattern Recognition and Machine Learning, Springer-Verlag (2006).
4. Michie D., Spiegelhalter D. J., Taylor C. C., Machine Learning, Neural and Statistical

FOR EXAMINATIONS TO BE HELD IN THE MAY 2024, 2025, 2026

Class: M. Tech 2nd Semester
Branch: CSE
Course Title: Object Oriented Modelling & Design
Course No.: MCSE202
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: This course provides a comprehensive introduction to Object Oriented Development. Participants will gain knowledge about different modelling techniques like state, class and interaction modelling. They will also come understand the development life cycle of process and gain the knowledge about various design patterns.

Course Outcomes: By the end of the course students shall be able to:

CO202.1	Describe the concepts of object-oriented and basic class modelling.
CO202.2	Draw class diagrams, sequence diagrams and interaction diagrams to solve problems.
CO202.3	Choose and apply a befitting design pattern for the given problem.

Detailed Syllabus

Unit 1: Introduction: What is Object Orientation? What is OO development? OO themes, Evidence for usefulness of OO development, OO modelling history. Modelling as Design Technique: Modelling, Abstraction; The three models. Class Modelling: Object and class concepts, Link and associations concepts, Generalization and inheritance, A sample class model, Navigation of class models. **(09 hrs)**

Unit 2: Advanced Class Modelling: Advanced object and class concepts; Association ends; N-ary associations; Aggregation; Abstract classes; Multiple inheritance; Metadata; Reification; Constraints; Derived Data; Packages. State Modelling: Events, States, Transitions and Conditions, State Diagrams, State diagram behaviour. Advanced State Modelling: Nested state diagrams; Nested states; Signal generalization; Concurrency; A sample state model; Relation of class and state models. **(10 hrs)**

Unit 3: Use Case Modelling and Detailed Requirements: Overview; Detailed object-oriented Requirements definitions; System Processes-A use case/Scenario view; Identifying Input and outputs-The System sequence diagram; Identifying Object Behaviour-The state chart Diagram; Integrated Object-oriented Models. **(08 hrs)**

Unit 4: Process Overview: Development stages; Development life Cycle. System Conception: Devising a system concept; Elaborating a concept; Preparing a problem statement. Domain Analysis: Overview of analysis; Domain Class model: Domain state model; Domain interaction model; Iterating the analysis. **(08 hrs)**

Unit 5: Use Case Realization: The Design Discipline within up iterations: Object Oriented Design-The Bridge between Requirements and Implementation; Design Classes and Design Class Diagrams; Interaction Diagrams- Realizing Use Case and defining methods; Designing with Sequence and Communication Diagrams;Updating the Design Class Diagram; Package Diagrams-Structuring the Major Components; Implementation Issues for 3- Layer Design. **(10 hrs)**

Unit 6: Introduction: what is a design pattern? Describing design patterns, the catalogue of design patterns, Organizing the catalogue, how design patterns solve design problems, how to select a design pattern, how to use a design pattern. Creational Patterns: Abstract Factory; Builder; Prototype; Singleton. Structural Patterns: Adaptor; Flyweight; Proxy. **(09 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

1 Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005
2 Satzinger, Jackson and Burd: Object-Oriented Analysis & Design with the Unified Process, Cengage Learning, 2005.
3 Erich Gamma, Richard Helm, Ralph Johnson and john Vlissides: Design Patterns –Elements of Reusable Object-Oriented Software, Pearson Education,2007.

FOR EXAMINATIONS TO BE HELD IN THE MAY 2024, 2025, 2026

Class: M. Tech 2nd Semester
Branch: CSE
Course Title: Information Storage & Management
Course No.: MCSE203

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: This course provides a comprehensive introduction to the fundamentals of Data Storage technology. Participants will gain knowledge of the core logical and physical components that make up a Storage Systems Infrastructure.

Course Outcomes: By the end of the course students shall be able to:

CO1	The demand from businesses for highly available and secure access to data
CO2	The Storage systems and infrastructure architectures and solutions available to support business needs
CO3	The key tasks in successfully managing and monitoring a data storage infrastructure.

Detailed Syllabus

UNIT 1: Introduction to Information Storage and Business Continuity: Meeting Today's Data Storage Needs, Value of data to business, Challenges in data storage and data management, List the solutions available for data storage, Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. **(09 hrs)**

UNIT 2: Information Storage & Data Center Infrastructure: Information Storage - Data, Types of Data, Big Data, Information, Storage, Evolution of Storage Architecture, Data Center Infrastructure - Core Elements, Key Characteristics, Managing a Data Center, Virtualization and Cloud Computing. **(06 hrs)**

UNIT 3: Data Protection using RAID: RAID Implementation Methods - Software RAID & Hardware RAID, RAID Array Components, RAID Techniques - Striping, Mirroring & Parity, RAID Levels - 0, 1, Nested, 3, 4, 5, 6, RAID Impact on Disk Performance, RAID Comparison, Hot Spares. **(08 hrs)**

UNIT 4: Fibre Channel Storage Area Networks: Overview, Components - Node Ports, Cables and Connectors, Interconnect Devices & SAN Management Software, FC Connectivity - Point-to-Point, Arbitrated Loop, Switched Fabric, FC-SW Transmission, Switched Fabric Ports, FC Architecture - FC Protocol Stack, FC Addressing &World-Wide Names, Zoning & its types, FC SAN Topologies - Mesh & Core-Edge Fabric. **(09 hrs)**

UNIT 5: Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits, File Systems and Network File Sharing, Components of NAS, NAS I/O Operation, NAS Implementations & Connectivity - Unified, Gateway and Scale-Out, NAS File-Sharing Protocols - NFS & CIFS, Factors Affecting NAS Performance. **(08 hrs)**

UNIT 6: Backup and Archive: Purpose, Considerations, Granularity, Recovery Considerations, Methods, Architecture, Restore Operations, Topologies, Backup in NAS Environments, Backup Targets - Disk, Tape & Tape Library, Backup in Virtualized Environments, Data Archive, Archiving Solution Architecture Use Case - E-mail Archiving & File Archiving. **(07 hrs)**

UNIT 7: Managing the Storage Infrastructure: Monitoring the Storage Infrastructure - Parameters, Components & Alerts, Management Activities - Availability, Capacity, Performance & Security Management, Reporting, Storage Infrastructure Management in a Virtualized Environment, Information Lifecycle Management. **(07 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

- Information Storage and Management, Wiley, EMC Educational Services
- Building Storage Networks, Tata McGraw Hill
- Storage Networks: The Complete Reference, Tata McGraw Hill

FOR EXAMINATIONS TO BE HELD IN THE MAY 2024, 2025, 2026

Class: M. Tech 2nd Semester
Branch: CSE
Course Title: Cloud Computing
Course No.: MCSE2A1
Duration Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview: The course introduces the principles of distributed and parallel computing underlying cloud architectures and specifically focuses on virtualization. It explains how to make design choices and trade-offs to consider when building applications to run in a virtual cloud environment.

Course Outcomes: By the end of the course students shall be able to:

CO1	Understand cloud computing models and architecture.
CO2	Understand security implications in cloud.
CO3	Analyse the operation , implementation and performance of cloud computing systems and relative merits and suitability of each for complex data intensive applications.
CO4	Analyse the migration risks and cost in cloud computing.

Detailed Syllabus

UNIT 1: Introduction: Historical and Evolution : Distributed Systems ,Virtualization, Web Service-Oriented Computing, Types of computing, Building Cloud Computing Environments, Principles of Parallel and Distributed Computing: Parallel vs. Distributed Computing, General Concepts , Definitions and Components of a Distributed System, Architectural Styles for Distributed Computing, Models for Inter-Process Communication, Technologies for Distributed Computing : Remote Procedure Call, Distributed Object Frameworks, Service Oriented Computing. **(08 hrs)**

UNIT 2: Introduction to Virtualization: Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Execution Virtualization, Other Types of Virtualization i.e. server, storage and network virtualization,Virtualization security threats and security recommendations Virtualization and Cloud Computing, Pros and Cons of Virtualization, Case Studies:Xen(Para virtualization), VMware(Full Virtualization),Microsoft(Hyper-V). **(10hrs)**

UNIT 3: Cloud Computing Architecture: Cloud Definition, Cloud Reference Model, Architecture, Infrastructure /Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds (Public, Private, Hybrid and Community), SaaS and Paas : Saleforce.com and Force.com , Migrating to cloud : Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud. **(10hrs)**

UNIT 4: Cloud Computing Issues and Challenges: Open challenges and benefits: Cloud interoperability, Scalability and Fault Tolerance, Cloud Bursting, Capacity Planning ,Load Balancing, Role of Service Oriented Architecture, Security Trust and Privacy Issues: Cloud Security, Threats to cloud, Infrastructure and Information Security, Cloud Security Management Framework, Security –as –a service, Privacy and Compliance Issues, Portability and Interoperability Issues. **(08 hrs)**

UNIT 5: Cloud Implementation and Environment :Technologies and Tools for Cloud Computing Aneka Cloud Platform, Aneka Resource Provisioning Service, Hybrid Cloud Implementation, Workflow Engine for Clouds: Workflow Management Systems and Clouds, Architecture of Workflow Management Systems, Utilizing Cloud for Workflow Execution, Data intensive computing: Technologies, Map Reduce Programming Model, SLA Management in Cloud Computing. **(10hrs)**

UNIT 6: Cloud Platforms in Industry: Amazon Web services, Elastic Compute Cloud (EC2), Simple Storage Services (S3), Simple Queuing Services(SQS), Google App Engine- PaaS, Windows Azure, A comparison of cloud computing platforms. **(08 hrs)**

Note: The Question paper will comprise of 7 questions of 15 marks each uniformly distributed over the entire syllabus based on teaching hours. The candidates shall have to attempt any 5 questions.

Suggested Books:

- Rajkumar Buyya , Christian Vecchiola, S ThamaraiSelvi, —Mastering Cloud Computing, McGraw Hill.
- Rajkumar Buyya , James Broberg, Andrzej Goscinski, — CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey
- T. Velte, A. Velte, R. Elsenpeter, Cloud Computing, A Practical Approach, McGraw-Hill, 2009Barrie Sosinsky, Cloud Computing Bible, Wiley
- Jurg Van Vliet and Flavia Paganelli, Programming Amazon EC2, O'Rielly

FOR EXAMINATIONS TO BE HELD IN THE MAY 2024, 2025, 2026

Class: M. Tech 2nd Semester
Branch: CSE
Course Title: IoT and its Industrial Applications
Course No.: MECE201
Duration of Exam: 3 HRS

L	T	P	C	Theory (External)	Internal
3	1	-	4	75	25

Course Overview:
In this course, student will explore various components of Internet of things such as Sensors, internetworking and cyber space. In the end they will also be able to design and implement IIoT circuits and solutions.

Course Outcomes:

CO1	Attain knowledge of IoT, design, Architecture, communication protocols and sensors.
CO2	Implement the concepts Python programming tools, Res-pi and Aurdino.
CO3	Analyze challenges in Iot and its applications in real time scenario.
CO4	While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.

UNIT 1: Introduction to IoT:
IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. **(8 Hours)**

UNIT 2: IoT to M2M: IoT and M2M fundamentals, Devices and gate ways, Definitions, M2M Value Chains, IoT Value Chains, Difference between IoT and M2M. **(6 Hours)**

UNIT 3:Network and communication protocol:
IoT standards and protocol, Wireless medium access issues, MAC control survey, constrained application protocol (CoAP). Message queue Telemetry transport protocol(MQTT), AMQP, security ion IoT protocol, Sensor deployment and node discovery, Data handling and analyst, Cloud Platform for IoTs. **(8 Hours)**

UNIT 4 Sensors and Actuators Modules:
Concept, layout, working and different applications of sensors and actuators, Temperature Sensor, Pressure Sensor, Proximity Sensor, Accelerometer and Gyroscope Sensor, IR Sensor, Optical Sensor, Gas Sensor, Smoke Sensor. ultrasonic sensor, relay. **(8 Hours)**

UNIT 5 Developing IoT based systems:
Introduction to Python, Implementing IoT concepts with python, Introduction to Arduino and Raspberry Pi programming, Implementation of IoT sensors with Arduino and Raspberry, Smartphone (Cellular), Bluetooth, LoRaWAN, Zigbee and wifi interfacing with R-Pi and Arduino. Introduction to ESP8266. **(12 Hours)**

UNIT 6: Control & Supervisory Level of Automation
Programmable logic controller (PLC), Real-time control system, Supervisory Control & Data Acquisition (SCADA). HMI in an automation process, ERP & MES. **(8 Hours)**

UNIT 7: Application of IIOT
Health monitoring, IOT smart city, Smart irrigation, Robot surveillance.Home Appliances Control Using Blynk Application, IIoT based smart energy meter. **(10 Hours)**

Note: The Question paper will comprise of 7 questions of 15 marks each, uniformly distributed over the entire syllabus based on teaching hours. The candidate shall have to attempt any 5 questions.

Suggested Books:

1. "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, 1st Edition, Academic Press, 2014.
2. "Internet of Things (A Hands-onApproach)", Vijay Madisetti and ArshdeepBahga, 1st Edition, VPT, 2014
3. "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",Francis da Costa, 1st Edition, Apress Publications, 2013
4. "Getting Started with the Internet of Things", Cuno Pfister, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1
5. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
6. Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
7. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)