Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Core Course	
Prerequisite	Programing Fundamentals, Data Structures, Mathematics	
Course Objective	To equip students with the skills to design, analyze, and implement efficient algorithms to solve computational problems	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Basics of Algorithms and Mathematics** What is an algorithm? Mathematics for Algorithmic, Sets , Functions and Relations, Vectors and Matrices , Linear Inequalities and Linear Equations. **Analysis of Algorithm** The efficient of algorithm, average and worst case analysis, elementary operation, Asymptotic Notation, Analyzing control statement, Analyzing Algorithm using Barometer, Amortized analysis, solving recurrence Equation, Sorting Algorithm, Binary Tree Search	**10**	**15**
2	**Greedy and Dynamic Programming Algorithmic Strategies** **Greedy strategy**: Principle, control abstraction, time analysis of control abstraction, knapsack problem, scheduling algorithms-Job scheduling and activity selection problem, Making change problem; Graphs: Minimum Spanning trees (Kruskal's algorithm, Prim's algorithm); Graphs: Shortest paths; The Knapsack Problem. **Dynamic Programming**: Principle, control abstraction, time analysis of control abstraction, binomial coefficient, 0/1 knapsack, Matrix Chain Multiplication, Longest Common Subsequence	**15**	**25**
3	**Graph Algorithms** Breadth First Search (BFS), Depth First Search (DFS) , Topological Sort Strongly Connected Components, Euler Tour Generic Minimum Spanning Tree, Kruskal's Algorithm, Prim's Algorithm, Single Source Shortest Path, Dijkstra's Algorithm, Bellman-Ford Algorithm	**15**	**20**
4	**Advanced Algorithms and Applications** Problem solving, Probabilistic analysis and randomized algorithms, Perfect Hashing, The Floyd - warshall algorithm, Johnson's algorithm for sparse graphs, NP-hard problems, Approximation algorithms, Online algorithms and competitive analysis. Linear- Programming Algorithms: Structure of Optima, Interior Point. Computational geometry: convex hull. Random Walks and Markov chains	**10**	**20**
5	**Algorithmic Case-studies** Internet of Things and Data Science Algorithms: Algorithms in IoT: Cryptography Algorithms, Scheduling Algorithms, Data management Algorithms and clustering, context management. Data Science Project Life Cycle(DSPLC), Mathematical Considerations: Mathematical modeling, Optimization Methods, Adaptive and Dynamic Algorithms and Numerical Analysis in IoT	**10**	**20**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

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Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	30	20	10	10	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Understanding of fundamental algorithms and data structures.
CO2	Development of strong problem-solving skills.
CO3	Cultivation of algorithmic thinking
CO4	Proficiency in implementing and programming algorithms.
CO5	Ability to analyze and evaluate algorithm efficiency and correctness.

Reference Books

1.	**Introduction to Algorithms (TextBook)** By Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein | MIT Press
2.	**Algorithms** By Robert Sedgewick & Kevin Wayne | Pearson Education
3.	**The Algorithm Design Manual (TextBook)** By Steve S. Skiena | Springer

List of Practical

1.	Convert a recursive program to an iterative program.
2.	Write programs for various paradigms such as Divide and Conquer, Dynamic Programming and Greedy Method.
3.	Write a program to B Tree algorithms
4.	Write a Code various sorting algorithms
5.	Work on graph with both representations: adjacency matrix and list
6.	Write code for various graph algorithms
7.	Write code for geometric algorithms

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Core	
Prerequisite	Computer Graphics Basics, Mathematics, Programming Skills	
Course Objective	Explore different Geometrical Transformations. Describe and apply Rendering Methods. Apply Image based Shading Methods. Understand and explore Radiosity and Texture Mapping. Summarize various challenges involved in Computer Graphics.	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**3D Transformation** • 3D-Geometrical Transformations • Shearing and reflection • 3D Clipping and Viewing Transformation • Representation of 3-D object in form of polygon mesh • Curve and surfaces • Parallel and perspective projection • Solid Modeling	**10**	**20**
2	**Illumination Model and Ray tracing** • Ambient Light, Diffuse Reflection, Atmospheric Attenuation • Visible surface detection concepts, back-face detection • Computer Animation ◦ Secular Reflection, Single and Multiple Light Sources • Recursive Ray Tracing Illumination Model • Intersection Computation, Shadows, Bounding Volumes • Backward vs. Forward Ray Tracing	**15**	**25**
3	**Rendering Polygonal Objects** • Blackface Culling, Clipping Algorithms • Image based Rendering • Rasterization, Hidden Surface Removal Z-buffer, and Shading Algorithms (*e.g.*, Gourd Shading and Phong Shading)	**15**	**20**
4	**Radiosity and photon Mapping** ◦ The Radiosity Matrix, Progressive Refinement ◦ Form Factors, the Hemi cube and Hemisphere methods, Other Radiosity Topics ◦ Photons, Photon Tracing, Photon Scattering ◦ Storing Photons • Rendering, Radiance Estimate	**10**	**15**

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5	**Texture Mapping and Meshes**	**10**	**20**

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Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	◦ Mapping During Modeling, Two-Stage Mapping ◦ Reverse Projection ◦ Mapping Polygons, Mapping Parametric Patches, Bump Mapping, View-Dependent Mapping, Procedural Texture Mapping • Mesh Definition and Generation • Mesh Simplification, Mesh Compression, Multi resolution Modeling • Morphing ,character animation and facial animation		
		Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	20	30	10	20	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Explore different Geometrical Transformations.
CO2	Describe and apply Rendering Methods.
CO3	Apply Image based Shading Methods.
CO4	Understand and explore Radiosity and Texture Mapping.
CO5	Summarize various challenges involved in Computer Graphics.

Reference Books

1.	**Computer Graphics (TextBook)** By Donald D. Hearn & M.Pauline Baker | Pearson Publication
2.	**Computer Graphics (TextBook)** By Donald Hearn and M.Pauline Baker | Donald Hearn and M. Pauline Baker
3.	**Computer Graphics C version** By Donald Hearn and M.Pauline Baker | PHI
4.	**Computer Graphics: A Programming Approach** By Steven Harrington | TMH

List of Practical

1.	Write a program to rotate a Circle around any arbitrary point or around the boundary of another circle.
2.	Write a menu driven program to rotate, scale and translate a line point, square, triangle about the origin.
3.	Write a program to perform shearing on a line.
4.	Write a program to implement polygon filling.
5.	Write a program to implement transformations in three dimensions.

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Core	
Prerequisite	Operating System Fundamentals, Networking Basics, Concurrent Programming	
Course Objective	To equip students with the knowledge and skills necessary to design, implement, and manage distributed operating systems, ensuring efficient resource sharing, fault tolerance, and scalability across multiple computing nodes	

Teaching Scheme (Contact Hours)				Assessment Scheme			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	3	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction to distributed Systems** Definition and goals, History, Centralized vs Distributed System, Hardware and Software concepts, Distributed computing models, Strengths and weaknesses of distributed, Design issues.	10	15
2	**Communication in distributed system** Computer Network and Layered protocols, Message passing and related issues, IPC, synchronization, Client Server model & its implementation, remote procedure call and implementation issues, Case Studies: SUN RPC, DEC RPC RMI basics, RMI Implementation, Java RMI. **Synchronization in distributed system** Clock synchronization and related algorithms, mutual exclusion, Deadlock in distributed systems. Election algorithms: Bully algorithm, Ring algorithm, Leader election in rings, Anonymous rings, Asynchronous rings, Synchronous rings.	15	25
3	**Processes and processors in distributed systems** Threads, system model, processor allocation. Scheduling in distributed systems: Load balancing and sharing approach. Fault tolerance, Real time distributed systems, Process migration and related issues.	10	20
4	**Distributed File Systems** Introduction, features & goal of distributed file system, file models, file accessing models. File sharing semantics, file caching scheme, file replication, fault tolerance, trends in distributed file system, Design Principles, Case study	10	20
5	**Distributed Shared Memory** Introduction, general architecture of DSM systems. Design and implementation issues of DSM, granularity, structure of shared memory space, consistency models, replacement strategy, thrashing.	10	20
	Total	55	100

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	30	20	20	10	10	10

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	dentify the advantages and challenges in designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement
CO2	Analyze different algorithms and techniques for the design and development of distributed systems subject to specific design and performance constraints.
CO3	Describe different types of faults and fault handling techniques in order to implement fault tolerant systems.

Reference Books

1.	**Distributed Operating System (TextBook)** By P.K.Sinha | PHI
2.	**Distributed Operating System (TextBook)** By Andrew S. Tanenbaum | Pearson Education
3.	**Distributed Computing** By Sunita Mahajan & Seema Shah | Oxford University Press

List of Practical

1.	Implement concurrent echo client-server application.
2.	Implement PI calculation Service using RPC programming.
3.	Implement Calculator Service using SUN RPC.
4.	Implementation of “Hello Word” Service using JAVA RMI.
5.	Implementation of “Calculator” Service using JAVA RMI.
6.	Mobile agent (IBM’s Aglet) Programming.
7.	Implement Network File System (NFS)

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Core	
Prerequisite	Mathematics, Operating System Fundamentals, Networking Basics	
Course Objective	To equip students with the knowledge and skills necessary to design, analyze, and implement cryptographic systems and network security protocols to protect data and ensure secure communication	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Basic Overview of Cryptography** Cryptography Attacks, Services and Techniques Symmetric Key ciphers and Asymmetric Cipher DES analysis, Security of DES, Transformation Analysis of AES	**10**	**15**
2	**Conventional Encryption Techniques** Conventional Encryption Algorithm Comparison between Algorithm(IDEA, DES, Triple DES,RC5, Blowfish) Random Number Generation Public Key Infrastructure Elliptic curve Arithmetic Diffie- hellman Key Exchange	**15**	**20**
3	**Message Authentication and Hash Function** Authentication and Authorization Authentication via key ownership Hash Function, Security of Hash Function Birthday Attack Generating and Exchanging Keys Non-repudiation using Digital Signature Key management, E-voting	**15**	**25**
4	**Intrusion Detection and Issues** Intrusion Detection Overview, Host based intrusion detection systems Network based intrusion detection systems, IDS as part of the overall Security System IDS Signatures and Analysis Schemes for Intrusion Detection Systems Anomaly detection, Expert Systems Tools for packet analysis and intrusion detection, Some intrusion detection Tools (Snort, Windup, Ethereal etc.)	**10**	**20**
5	**Network security and IP Security** Digital Signature in the real world Digital Certificate Kerberos, Authentication Protocol IP Security: IP security Architecture, Authentication Header Encapsulating Security Payload, PGP,S/MIME Secure Socket Layer(SSL):Architecture, Protocol Secure Electronic Transaction(SET):Services, Requirement, Features, Participants, Firewall Design Principles	**10**	**20**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	20	30	20	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Understand different security models and attacks
CO2	Enable the students to learn fundamental concepts of computer security and cryptography and utilize these techniques in computing systems.
CO3	Understand management issues and algorithm
CO4	Understand different security issues and their types
CO5	Study and evaluate different encryption techniques of cryptography
CO6	Configuration of ecryption algorithm and check their output

Reference Books

1.	**Cryptography and Network Security (TextBook)** By William Stalling | Pearson
2.	**Network Security Essentials** By William Stalling | Pearson

List of Practical

1.	Implement the Pure Transposition Cipher
2.	Implement DES Encryption and Decryption.
3.	Draw diagram of Public Key Infrastructure.
4.	Draw diagram of Centralized/Decentralized Infrastructure.
5.	Implement the AES Encryption and decryption.
6.	Implement RSA Encryption Algorithm.
7.	Implementation of Hash Functions.
8.	Demonstrate Sniffing using packet tool.
9.	Draw diagram Host-based Intrusion Detection System.
10.	Configure your e-mail account against various threats. i.e. spam attack, phishing, spoofing etc.

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Core	
Prerequisite	Basic Research Methods, Data Analysis	
Course Objective	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling. Have basic knowledge on qualitative research techniques. Apply Literature Review approach on Research problems Demonstrate Research skills by analyzing and understanding Referencing Styles. Apply and Demonstrate paper writing skills.	

Teaching Scheme (Contact Hours)				**Assessment Schee**			
Lecture	**Tutorial**	**Lab**	**Credit**	**Theory Marks**		**LAB**	**Total Marks**
				SEE	**CIA**		
0	0	8	4	-	-	100	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**How to Start Research** Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.	**15**	**25**
2	**Research problem Formulation** Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, Research Design	**15**	**25**
3	**Research Publication & Presentation** Effective literature studies approaches, analysis, Plagiarism , Research ethics, Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	**15**	**25**
4	**Research Ethics and Morals** Issues related to plagiarism and ethics. Intellectual Property Rights: Copy rights, Patents, Industrial Designs, Trademarks.	**15**	**25**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Understanding	Analyze	Evaluate	Create
Weightage	25	25	25	25

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Develop understanding on various kinds of research, objectives of doing research, research process, research designs and sampling.
CO2	Have basic knowledge on qualitative research techniques.
CO3	Apply Literature Review approach on Research problems.
CO4	Demonstrate Research skills by analyzing and understanding Referencing Styles.
CO5	Apply and Demonstrate paper writing skills.

Reference Books

1.	**Research Methodology, Methods & Techniques (TextBook)** By C.R. Kothari | Viswa Prakashan, 2nd Edition, 2009
2.	**Research Methodology: An Introduction** By Wayne Goddard and Stuart Melville | Juta and Company Ltd, 2004
3.	**How to Write a Thesis (TextBook)** By R. Murray | Tata McGraw Hill, 2nd Edition, 2010

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Elective	
Prerequisite	Mathematics, Programming Skills, Machine Learning Basics, Data Handling	
Course Objective	To equip students with the knowledge and skills necessary to design, implement, and evaluate intelligent systems using AI techniques and methodologies	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction to Artificial Intelligence Overview** • What is AI ?,Importance and early work in AI • AI related fields • Defining problems as a state space search, Production systems • Production Characteristics, Production System Characteristics • Issues in the Design Of Search Programs • Additional Problems. • Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction • Means-Ends Analysis	**10**	**20**
2	**Knowledge Representation** ◦ Knowledge Representation Issues :Representations And Mappings ◦ Approaches to Knowledge Representation ◦ Using Predicate Logic Representation Simple Facts in Logic ◦ Representing Instance and ISA Relationships ◦ Computable Functions And Predicates ◦ Representing Knowledge Using Rules, Procedural Versus Declarative Knowledge • Logic Programming, Forward Versus Backward Reasoning	**15**	**20**
3	**Search and Control Strategies, Reasoning** • Search and Control Strategies :Uninformed(Blind) and informed search • DFS, BFS, Heuristic Search Techniques : Generate-And-Test, Hill Climbing, Best-First Search, A*, AO*, Problem Reduction, Constraint Satisfaction • Reasoning: Symbolic Reasoning Under Uncertainty • Introduction to Non-monotonic Reasoning • Logics for Non-monotonic Reasoning. Statistical Reasoning • Probability And Bay's Theorem, Certainty Factors And Rule-Base Systems • Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic	**15**	**20**
4	**Game Playing and Expert System**	**10**	**20**

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- Overview, Mini Max, Alpha-Beta Cut-off, Refinements, Iterative deepening
- The Blocks World, Components of A Planning System
- Goal Stack Planning, Nonlinear Planning Using Constraint Posting
- Hierarchical Planning, Reactive Systems, Other Planning Techniques
- Expert System: Introduction, Architecture and Types of Expert System

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
5	**Natural Language Processing and Introduction to Prolog** • Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Spell Checking • Introduction: Hopfield Network, Learning in e- Network, Application of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI • Introduction To Prolog: Syntax and Numeric Function, Basic List Manipulation, Functions in Prolog, Predicates and Conditional, Input, Output and Local Variables	**10**	**20**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	30	30	10	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Explain AI techniques, models, criteria, and search techniques
CO2	Analyse knowledge representation
CO3	Learn Symbolic reasoning and probabilistic reasoning
CO4	Describe Game playing and planning of different types
CO5	Understanding natural language processing and connectionist models.

Reference Books

1.	**Neural Networks, Fuzzy logic and Genetic algorithms (TextBook)** By S. Rajasekaran, G. A. Vijayalakshmi Pai | PHI publication
2.	**Artificial Intelligence (TextBook)** By laine Rich And Kevin Knight | Tata Mcgraw-Hill
3.	**PROLOG Programming For Artificial Intelligence** By Ivan Bratko | Pearson Education
4.	**Artificial Intelligence: A Modern Approach** By Stuart Russel, Peter Norvig, | PHI

List of Practical

1.	Write a program to implement Tic-Tac-Toe game problem.
2.	Write a program to implement BFS (for 8 puzzle problem or Water Jug problem or any AI search problem).
3.	Write a program to implement BFS (for 8 puzzle problem or Water Jug problem or any AI search problem)

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4.	Write a program to implement Single Player Game (Using Heuristic Function).

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5.	Write a program to Implement A* Algorithm.
6.	Write a program to solve N-Queens problem using Prolog.
7.	Write a program to solve 8 puzzle problem using Prolog.
8.	Write a program to solve travelling salesman problem using Prolog.

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Elective	
Prerequisite	Programming Skills, Operating System Fundamentals, Networking Basics	
Course Objective	To equip students with the knowledge and skills necessary to effectively design, implement, and manage big data solutions using Hadoop and its ecosystem	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction to Big Data and Hadoop** Introduction to Big Data, Definition and characteristics of Big Data, Types of data and their sources, Challenges in processing and analyzing Big Data, Introduction to Hadoop, Overview of Hadoop and its architecture, Hadoop Distributed File System (HDFS), MapReduce paradigm	**10**	**15**
2	**Hadoop Ecosystem** HBase, Hive, Pig, Sqoop, Flume components. Roles and functionalities of Hadoop ecosystem components. **Hadoop MapReduce:** MapReduce programming model. Writing MapReduce jobs in Java. Hands-on exercises. **Apache Hive and Pig:** Introduction and features. Querying and analyzing data in Hive using HiveQL. Hive data modeling and optimization techniques. Introduction to Apache Pig and its features. Data transformation and analysis using Pig's Pig Latin scripting language	**15**	**20**
3	**Real-time Data Processing and Integration** Apache Kafka, Introduction to Apache Kafka and its architecture, Kafka producers and consumers, Real-time data ingestion and processing with Kafka, Apache Spark Introduction to Apache Spark and its features, Spark RDDs and DataFrames Spark SQL for querying and analyzing data	**10**	**20**
4	**NoSQL Databases and Advanced Hadoop Concepts** NoSQL Databases and Hadoop Integration, Introduction to NoSQL databases (e.g., HBase), Integration of NoSQL databases with Hadoop, Hands-on exercises, Advanced Hadoop Concepts, Data partitioning and optimization techniques, Cluster management and monitoring tools (e.g., Apache Ambari) Performance tuning and scalability considerations	**10**	**20**
5	**Big Data Analytics with Hadoop**	**15**	**30**

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	Introduction to machine learning, data mining, and predictive modeling with Hadoop. **Data Security and Governance in Hadoop:** Overview of data security challenges, securing data at rest and in transit, and compliance considerations. **Real-world Use Cases and Project Work:** Exploration of real-world applications, analysis of case studies, and hands-on projects using Hadoop tools. **Project Presentations and Wrap-up:** Final project presentations, course recap, and discussion of future trends in Big Data and Hadoop.

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Total	**60**	**105**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy					
Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	10	20	30	20	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books

1.	**Hadoop: The Definitive Guide (TextBook)** By Tom White | O'Reilly Media
2.	**Hadoop in Practice** By Alex Holmes | Manning Publications
3.	**Apache Kafka: The Definitive Guide (TextBook)** By Neha Narkhede | O'Reilly Media

List of Practical

1.	Setting up Hadoop Cluster: Install and configure Hadoop, HDFS, and MapReduce.
2.	Data Ingestion and Processing: Use Sqoop or Flume to ingest large-scale data into Hadoop. Process data with MapReduce or Apache Pig.
3.	Data Querying and Analysis with Hive: Create tables in Hive, load data, and execute HiveQL queries.
4.	Data Transformation and Analysis with Pig: Write Pig Latin scripts for data transformation and analysis.
5.	Real-time Data Processing with Kafka and Spark: Set up Kafka for real-time data ingestion. Develop Spark Streaming applications.
6.	Integrating NoSQL Databases: Install and configure a NoSQL database like HBase within Hadoop.
7.	Machine Learning with Hadoop: Preprocess data using Hive, Pig, or Spark. Implement machine learning algorithms.
8.	Project Work: Undertake a hands-on project using Hadoop tools. Implement data analysis, processing, and visualization

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Course	Master of Technology (M.Tech.)	**Semester - 1**
Type of Course	Elective Courses	
Prerequisite	03080101-T - PROGRAMMING IN C	
Course Objective	1. To understand the Fundamental of Database Management System, RDBMS and locking mechanism. 2. To learn the fundamental of data models and SQL query. 3. To develop application using PL/SQL blocks.	

Teaching Scheme (Contact Hours)				**Assessment Schee**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction to Database System Concepts and Architecture** Database and Users: Introduction (Basic Concepts: Data, Database, Database systems, Database Management Systems), Characteristics of Database Approach, Advantages of using the DBMS approachDatabase System Concepts and Architecture, Data Models, Schemas, Instances, the three schema architectures and data independence, Database Languages and interfaces, Database System environment, Centralized and client / Server Architecture for DBMS, Classifications of Database Management Systems	**12**	**20**
2	**Entity Relationship Diagram** Using high level conceptual data models for database design (Design Phases of database design), Entity types, Entity Sets, Attributes and keys, Relationship Types, Relationship sets, Roles and structural constraints, Weak entity Types, Refining the ER diagram for company Database, Entity Relationship Diagram Naming conventions Design issues, Example of other Notation: UML class diagram, Relationship types of degree higher than 2 Subclasses, Super Classes, Inheritance Specialization and GeneralizationRelational Database design by ER and EER to Relational Mapping, Mapping EER model construct to Relations	**12**	**20**
3	**Database Design** Informal Design Guidelines for Relational Schema, Functional Dependencies, Normal Forms based on Primary keys, General definitions of 1NF, 2NF and 3NF, Boyce-Codd Normal Forms (BCNF), Multi-valued Dependency and Fourth Normal Form	**12**	**20**
4	**Transaction processing** Introduction to Transaction Processing Concepts: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, characterizing Schedules based on recoverability and Serializability	**12**	**20**
5	**Relational Model Concept** Relational Model concepts: Relational Model concepts, Relational Model constraints and Relational Database Schemas	**11**	**20**
	Total	**59**	**100**

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Suggested Distribution Of Theory Marks Using Bloom's Taxonomy					
Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	20	20	10	20	30

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Learn how to manage databases and their relations.
CO2	Design the database schema with the use of appropriate data types for data storage in database.
CO3	Understand the uses the database schema and need for normalization
CO4	Use different types of physical implementation of database and understand ER diagram.
CO5	Write a program using SQL queries to implement join and trigger.

Reference Books

1.	**Fundamentals of relational database management systems (TextBook)** By S.Sumathi | Springer
2.	**Relational Database** By Dr.ms.Manisha Bharamde and Abhijeet D.Mankar | Nirali Prakashan

List of Practical

1.	Construct an E-R diagram for a hospital with a set of patients and a set of medical doctors. Associate with each patient a log of the various tests and examinations conducted
2.	Consider the enitity EMPLOYEE with following attributes: Practical on RDBMS . Emp-ID Employee-Name Address Phone Dependent-Name Relationship~to~Employee Skill Designation Designation-Start-Date Salary Salary-StarLDate Using the EMPLOYEE entity, convert each of the one-to-many association into a weak entity and a relationship. Identify the discriminator of each weak entity and the attributes of each relationship.
3.	The people's Bank offers five types of accounts: loan, checking, premium savings, RDBMS daily interest saving, and money market. It operates a number of branches and a client of the bank can have any number of accounts. Accounts can be joint, i.e., more than one client may be able to operate a given account. Identify the entities of interest and show their attributes. What relationships exist anlong these entities? Draw the corresponding E-R diagram
4.	A University decides to computerise it's registration system. Identify the possible entities and relationships and Draw the E-R Diagram.
5.	In the Database file Add these Fields: (Total: Datatype- Number 3 digits, Percentage: Datatype – Number 3 digits with 2 decimal places, Grade: Datatype- Char with 2 letters)
6.	Create Marksheet table and Insert more 3 records in MARKSHEET using SQL mode.
7.	Update the values for newly added columns i.e. Total, Percentage, Grade table using UPDATE command.
8.	Display all records of the marksheet table, write SQL command.
9.	Display all records of the marksheet table, write SQL command.
10.	Display name, rollno, marks of 3 subjects, total and percentage using design view
11.	Write SQL command to display name, rollno, grades from the marksheet table.
12.	Display the maximum and minimum marks for Sub101 using design.
13.	Display the sum of marks for Sub102 using SQL command
14.	Display the rollno, student name and percentage whose name starts with A using SQL command.

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15.	Display the rollno, student name and percentage whose name second letter is i using SQL command

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Course	Master of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core course for Data Science	
Prerequisite	3080602 Data Warehouse and mining	
Course Objective	To provide an in-depth understanding of data warehousing, OLAP technology, and data mining techniques, along with practical applications and tools.	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	-	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction to Data Warehouse and OLAP Technology for Data Mining** • What is Data Warehousing, Data Warehousing concepts, Methodology for Data Warehousing, Issues in Data Warehousing, Benefits of Data Warehousing. • Data Warehouse and Data Mart, Metadata, Use of metadata in Data Warehouse, Tools for metadata. • Multidimensional data Model, Data warehouse Data Model, Data warehouse Architecture, Data warehouse Implementation. • Development of Data Cube Technology, OLAP in the Data Warehouse, Demand for OLAP, Major features and Functions (Drill-down, Rollup, Slice, Dice), OLAP Models, OLAP Tools • From Data warehousing to Data Mining.	**10**	**20**
2	**Introduction to Data Mining and Data Pre-processing** • Basics of Data Mining, Importance of Data Mining, Data Mining functionalities, Classification of Data mining systems. • Data mining architecture, KDD Process, Major Issues in Data Mining, Applications of Data Mining, Social impacts of data mining. • Integration of a Data Mining system with a Database or a Data Warehouse. • Data Pre-processing and its need. • Data cleaning: Missing Values, Noisy Data, Data Integration and transformation, Data Reduction: Data cube aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction. • Data Mining Primitives, Languages and System Architectures: Task relevant data, Kind of Knowledge to be mined, Discretization and Concept Hierarchy, Mining Class Comparison.	**20**	**30**
3	**Association Rule Mining** • Basic Concepts, Market Basket Analysis, Mining of Single dimensional Boolean association rules, Multilevel association rules and Multidimensional association rules • Correlation Analysis, Constraint based association Mining • Finding frequent item sets, Support and Confidence. • Apriori algorithm, generating rules, Improved Apriori algorithm, Incremental ARM, Associative Classification, Rule Mining.	**10**	**15**
4	**Classification and Predication** • Classification and Prediction, Basic Concepts, Basic issues regarding classification and predication. • Classification by Decision Tree, Bayesian classification, classification by back propagation, Associative classification. • Classification Based On Concepts From Association Rules Mining, Other Methods, Such As Genetic Algorithm, Fuzzy Set Approach, Case Based Reasoning, Etc., • Prediction, Classifier Accuracy, Linear and nonlinear regression, Logistic Regression	**10**	**15**

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5	**Cluster Analysis and Mining complex Types of data**	**10**	**20**

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Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	◦ Cluster Analysis: An Overview & Basic Concepts, basic issues, clustering using partitioning methods, Hierarchical methods, Density based methods, Grid based methods and model based methods, Algorithms for outlier analysis. • Mining complex Types of data: Multidimensional analysis and descriptive mining of complex data objects, Introduction to spatial mining, multimedia mining, temporal mining, text Mining, Time Series & Sequence Data and web mining with related algorithms.		
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	10	30	10	20	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Understand the functionality of the various data mining and data warehousing component
CO2	Appreciate the strengths and limitations of various data mining and data warehousing models
CO3	Explain the analyzing techniques of various data using OLAP Cube
CO4	Describe different methodologies used in data mining and data ware housing.
CO5	Compare different approaches of data ware housing and data mining with various technologies

Reference Books

1. **Data Mining – Concepts & Techniques (TextBook)**
   By Jiawei Han Micheline Kamber | Morgan Kaufmann Publishers
2. **Mordern Data Warehousing, Data Mining and Visualization (TextBook)**
   By George M. Marakas | Pearson
3. **Data Mining**
   By Vikram Puri P.RadhaKrishana | Oxford Press
4. **Data Mining**
   By Arun K. Pujari | University Press

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List of Practical	
1.	Write a Java code to Generate Random 10,000 numbers and store into csv file.
2.	Write a Java code to Generate Random 10,000 numbers and store as 100*100 array in csv file and then apply any sorting method on the same data.
3.	Write a C++/C#/JAVA program to perform min-max normalization, z-score normalization and decimal scaling operation.
4.	Write a Program of Binning Methods for data smoothing.
5.	Write a Java code to implement the Apriori Algorithm.
6.	Write a Java code Find frequent item set using FP growth method.
7.	Write a Java code to implement naive based Algorithm.
8.	Write a Java code to implement K-means algorithm.
9.	Study WEKA (Data Mining Tool). Install WEKA and shows you how to use the Weka machine learning workbench. Explain how Machine Learning Tools, techniques and data mining algorithms works.
10.	Perform K-Means Algorithm with the help of WEKA.

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Course	Master of Technology (M.Tech.)	**Semester - 3**
Type of Course	Core Courses	
Prerequisite	02070503-T - COMPUTER NETWORKS	
Course Objective	1. To learn how to use Cloud Services 2. To implement Virtualization, Task scheduling algorithm and to build private network. 3. Apply Map-reduce concept to applications	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	0	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction** Cloud Computing, Layers and Types of Clouds, Cloud Infrastructure Management, Challenges and Applications. Virtualization: Virtualization of Computing, Storage and Resources. Cloud Services: Introduction to Cloud Services IaaS, PaaS and SaaS	**10**	**15**
2	**Software as a Service (SaaS)** Evolution of SaaS, Challenges of SaaS Paradigm, SaaS Integration Services, SaaS Integration of Products and Platforms. Infrastructure As a Services (IaaS): Introduction, Background & Related Work, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, VM Provisioning and Migration in Action. Platform As a service (PaaS): Integration of Private and Public Cloud, Technologies and Tools for Cloud Computing, Resource Provisioning services	**15**	**20**
3	**Abstraction and Virtualization** Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding Hyper visors, Understanding Machine Imaging, Porting Applications, Virtual Machines Provisioning and Manageability Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Center Automation	**15**	**20**
4	**Cloud Infrastructure and Cloud Resource Management** Architectural Design of Compute and Storage Clouds, Layered Cloud Architecture Development, Design Challenges, Inter Cloud Resource Management, Resource Provisioning and Platform Deployment, Global Exchange of Cloud Resources. Administrating the Clouds, Cloud Management Products, Emerging Cloud Management Standards.	**10**	**20**
5	**Security** Security Overview, Cloud Security Challenges and Risks, Software-as-a Service Security, Cloud computing security architecture: Architectural Considerations, General Issues Securing the Cloud, Securing Data, Data Security, Application Security, Virtual Machine Security, Identity and Presence, Identity Management and Access Control, Autonomic Security Establishing Trusted Cloud computing, Secure Execution Environments and Communications, , Identity Management and Access control Identity management, Access control, Autonomic Security Storage Area Networks, Disaster Recovery in Clouds.	**10**	**25**

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Total	**60**	**100**

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Suggested Distribution Of Theory Marks Using Bloom's Taxonomy					
Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	20	20	20	10	30

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Analyze the different layers Cloud computing using different architectures with it's advantages and disadvantages.
CO2	Explore the Cloud Architecture along with IaaS, SaaS, PaaS using Application Frameworks.
CO3	Use the concept of Abstraction and Virtualization of CPU, Memory , I/O Devices, Virtual Clusters and Resource management
CO4	Understand the Cloud Infrastructure and Resource Management in Cloud Computing
CO5	Learn about Cloud Security to overcome different types of Challenges and Risks.

Reference Books

1.	**1. Cloud Computing: Principles and Paradigms (TextBook)** By Rajkumar Buyya, James Broberg, Andrzej M Goscinski | Wiley publication

List of Practical

1.	Cloud SPI models.
2.	Case studies on :Infrastructure as a Service (IaaS),Virtualization, Platform as a service
3.	Case Study on: (PaaS), Cloud platform management.
4.	Case Study on: Software as a Service
5.	Data security and Storage, Data privacy, Access management, Cloud computing standards and Interoperability
6.	Case Study: Amazon Web Services
7.	Case Study on Cloud simulation Tool Kit.

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Course	Master of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core course for Computer Science/Web Development.	
Prerequisite	3080501-Web Technology	
Course Objective	To equip students with comprehensive knowledge and practical skills in both client-side and server-side web technologies, including content management systems, web security, and text and web mining techniques.	

Teaching Scheme (Contact Hours)				Assessment Scheme			
				Theory Marks			
Lecture	Tutorial	Lab	Credit	SEE	CIA	LAB	Total Marks
3	-	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Web Technologies Introduction** Introduction ,Web Essentials: Clients, Servers, Communication, Basic Internet Protocols, HTTP Request Message, HTTP Response Message, HTTPS protocol, Web Clients, Generations of web applications	10	15
2	**Introduction to Client-Side Programming** Introduction to JavaScript, Basic Syntax, Variables and Data Types, Statements, Operators, literals, functions. JavaScript Objects–properties, references, methods, constructors, Arrays, other built-in objects, Debugging JavaScript, Introduction to Host Objects, Document Object Model (DOM), Document tree, DOM event handling, JQuery, YUI Library	10	20
3	**Server-Side Programming** **Java servlet:** architecture, life cycle. The Client Request – form data, request headers. The Server Response- HTTP Status Codes, HTTP Response Headers. Sessions, Cookies, URL Rewriting, Concurrency in servlets, **Separating Programming and Presentation:** Java server pages, Basic JSP, JavaBeans Classes and JSP, JSF, Java Database Connectivity (JDBC), PHP	10	20
4	**Content Management Systems** Introduction to CMS, advantages using CMS, CMS development tools: Wordpress, Drupal, Joomla. Wordpress: content and conversion, directory, file structure, local working, component administration, core, loop, data management, Wordpress as CMS, Wordpress in enterprise. Website Deployment: Domain registration, Domain hosting, parking websites, uploading data using FTP, email configuration. AJAX	15	20
5	**Text and Web Mining** Text mining: Text Data Analysis and Information Retrieval, Dimensionality Reduction for Text, Feature vector, Bag of words, Tf-idf, Text Mining Approaches, Web mining: Introduction, web content mining, web usage mining, web structure mining, web crawlers**.**	10	15
6	**Web configuration security** Apache Security, Nginx Security, jBoss Remote Command Execution ,Tomcat RemoteCommand Execution ,HTTP Parameter Pollution	5	10
	Total	60	100

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Evaluate	Create
Weightage	25	35	10	10	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may

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vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Enhanced ability to design and develop interactive web applications.
CO2	Improved understanding of web development languages, frameworks, and tools.
CO3	Increased proficiency in creating responsive and mobile-friendly web designs.
CO4	Knowledge of web security principles and practices to protect against cyber threats.
CO5	Improved problem-solving skills through hands-on experience with web technologies.
CO6	Expanded career opportunities in the rapidly evolving field of web development.

Reference Books

1.	**Web Technologies : A Computer Science Perspective (TextBook)** By Jeffrey C.Jackson | Pearson Education, 2nd edition
2.	**Java Servlet Programming** By Jason Hunter | O'reilly Publications, 2nd Edition

List of Practical

1.	Assume that the information regarding the marks for all the subjects of a student in the last exam are available in a database, Develop a Servlet which takes the enrollment number of a student as a request parameter and displays the marksheet for the student.
2.	Create two textboxes on the HTML page named login and password. After clicking on i. the 'login' button the servlet will be displayed. It will show 'login successful' upon correct password else 'authentication failure' will be displayed. Make the use of HTTP Servlet or Generic Servlet. ii. Write a program to demonstrate the use of servlet request and response as well as doGet ( ) and doPost( ) methods.
3.	Write a simple JSP page to display a simple message (It may be a simple html page).
4.	Design a website using Content management system of WordPress. Make the use of different plugins and themes of the WordPress.

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Course	Masters of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core Courses	
Prerequisite	03070603-T - OBJECT ORIENTED ANALYSIS AND DESIGN WITH UML	
Course Objective	1. To assist the student in understanding the basic theory of software engineering 2. To apply these basic theoretical principles to a group software development project	

Teaching Scheme (Contact Hours)				**Examination Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	1	0	4	70	30	0	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**INTRODUCTION** Definition, Programs v/s Software products, Software, Changing nature of software, Software Myths, Emergence of SE, Changes in Software development, Computer system engineering, Layered technology, Process Framework, CMMI, Personnel and team process models, software reliability, software quality, ISO9000 Certification	**15**	**25**
2	**SOFTWARE MODELS , PROJECT MANAGEMENT** Use of life cycle model, Process models, Comparison of models, Responsibility of project manager, Skills needed for SPM, Project Planning, SPMP Document, Project size estimation-LOC, FPM. Project estimation techniques-empirical, heuristic and analytical techniques. Scheduling- Ghant chart and Pert Chart, Staffing, Risk Management- identification, assessment, containment	**15**	**25**
3	**REQUIREMENT ANALYSIS AND SPECIFICATION** Goal of requirement and specification, Phases, Requirement engineering tasks, Software Requirement Specification(SRS), Characteristics of good & bad SRS document, Formal Techniques	**10**	**15**
4	**DATA ORIENTED ANALYSIS AND DESIGN** Difference between Data and Information, E-R Diagram, Control and Process Specification, Data Dictionary, Objective, What is good software design, Cohesion and Coupling, Software design approaches and d/b them, Structured Analysis, DFD's and its symbols, Structures design, Flowchart v/s Structure chart, Transformation of DFD model into Structured Chart—transform and transaction, Design Review, Design process, quality and guidelines, Design CONCEPTS, Design model- structure, behavior and architectural	**10**	**20**
5	**TESTING** Concepts, Psychology of testing, Levels of testing, White-Box testing, Black-box testing	**10**	**15**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze
Weightage	30	30	20	30

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Discuss Software Devlopment Life Cycle and its importance
CO2	Develop some basic level of software architecture
CO3	Understanding the concept and Importance of Software Project Management.
CO4	Diffrerentiate between Various Testing Technique.
CO5	Compare different Software Devlopment Process Models.

Reference Books

1.	**Fundamentals of Software Engineering** By Rajib Mall | PHI
2.	**Software Engineering : A Practitioner's Approach (TextBook)** By Roger S. Pressman | McGraw-Hill

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Course	Masters of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core Courses	
Prerequisite	3070402-Computer Organization and Architecture	
Course Objective	1. To provide a comprehensive understanding of Service-Oriented Architecture (SOA) principles, design and implementation techniques, and the integration of web services with emerging trends such as cloud computing and microservices, along with hands-on project experience.	

Teaching Scheme (Contact Hours)				**Examination Scheme**			
				Theory Marks		**LAB**	
Lecture	**Tutorial**	**Lab**	**Credit**	**External Mark (T)**	**Internal Marks (T)**		**Total Marks**
3	1	0	4	70	30	0	100

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction to Service-Oriented Architecture** • Evolution of software architectures • Basics of SOA Benefits and challenges of SOA	**15**	**20**
2	**Service-Oriented Analysis and Design** • Service-oriented analysis (SOA) • Service identification and specification • Service modeling techniques Service composition and choreography	**15**	**15**
3	**Web Services and Interoperability** • Introduction to web services • XML, SOAP, and WSDL • RESTful services Web service interoperability	**10**	**20**
4	**Service Orchestration, Choreography, and Governance** • Orchestration vs. choreography • BPEL (Business Process Execution Language) • Workflow management systems • Service governance framework • Service lifecycle management • Service discovery and registry Service monitoring and management	**10**	**15**
5	**Security, Quality of Service, Cloud Computing, and Emerging Trends**	**10**	**15**

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- Security challenges in SOA
- Authentication and authorization
- Secure web services
- Quality of Service (QoS) in SOA
- SOA and cloud computing
- Cloud service models (IaaS, PaaS, SaaS)
- Cloud service integration
- Cloud-native architectures
- Current research trends in SOA
- Micro services architecture
- Server less computing

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	API management and integration		
6	**Case Studies, Real-world Implementations, and Project Work** • Case studies of successful SOA implementations • Industry best practices • Lessons learned and challenges faced Students will be required to work on a project related to the design, implementation, and evaluation of a service-oriented architecture. The project may involve the development of a prototype, the analysis of an existing system, or the evaluation of different SOA frameworks and tools.		
		Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy				
Level	Remembrance	Understanding	Application	Analyze
Weightage	30	30	20	20

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Books Recommended		
Title of the Book	**Author**	**Publication**
Service-Oriented Architecture: Concepts, Technology, and Design	Thomas Erl	Prentice Hall
Service-Oriented Architecture (SOA): Concepts, Technology, and Implementation	Michael Bell	Wiley
Enterprise SOA: Service-Oriented Architecture Best Practices	Dirk Krafzig, Karl Banke, and Dirk Slama	Prentice Hall
Reading Resources and Research References		
1. IIT-Bombay tutorials 2. NPTEL tutorials		
Mode of Evaluation	Internal and External	
Recommended by the Board of Studies		
Date of Approval by the Academic Council		

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Course	Master of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core course for Computer Science/Image Processing.	
Prerequisite	3060302-Digital Logic Design	
Course Objective	To provide an in-depth understanding of digital image processing techniques, including image enhancement, restoration, compression, and segmentation, along with practical applications and mathematical foundations.	

Teaching Scheme (Contact Hours)				Assessment Scheme			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	-	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Introduction of Digital Image Processing** • Introduction, components of Digital Image Processing, examples • Steps in Digital Image Processing • Elements of Visual perception, Light and Electromagnetic spectrum • Image Sensing and application • Image sampling and quantization, Basic relationships between pixels, mathematical tools	10	15
2	**Image Enhancements** ◦ In spatial domain: Basic gray level transformations ◦ Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters ◦ Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters • Sharpening frequency domain filters	15	25
3	**Image Restoration and Color Image Processing** • Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering • Color Image processing: Color fundamentals, Color models, Color transformation, Smoothing and Sharpening, Color segmentation	15	25
4	**Wavelet and Multi resolution processing and Image Compression** ◦ Image pyramids, Multi-resolution expansion, wavelet transform ◦ Image Compression: Introduction, Image compression model • Huffman Coding ,Arithmetic coding, Digital Image water marking	8	15
5	**Morphological Image processing and Image segmentation:** • Preliminaries, Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformation, Basic morphological algorithms for boundary extraction, Region filling, extraction of connected components, thinning and thickening. • Image segmentation: Detection of discontinuities, Edge linking and boundary detection, thresholding	12	20
	Total	60	100

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Evaluate	Create

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Weightage	20	20	20	10	30

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes	
At the end of this course, students will be able to:	
CO1	Understanding of fundamental concepts and techniques in digital image processing.
CO2	Proficiency in image enhancement, restoration, and segmentation methods.
CO3	Ability to apply various image filtering and transformation operations.
CO4	Skill in implementing image processing algorithms using software tools.
CO5	Knowledge of advanced topics such as image recognition, pattern recognition, and computer vision.

Reference Books	
1.	**Digital Image Processing (TextBook)** By Rafel C. Gonzalez and Richard E. Woods | Pearson Education, latest edition
2.	**Digital Image Processing (TextBook)** By Bhabatosh Chanda and Dwijesh Majumde | PHI
3.	**Fundamentals of Digital Image Processing** By Anil K Jain | PHI
4.	**Digital Image Processing Using Matlab** By Rafel C. Gonzalez and Richard E. Woods | Pearson Education

List of Practical	
1.	Image Enhancement: Point Processing Techniques, Histogram Equalization.
2.	Image Enhancement: Estimate noise parameter of noisy image and design filter to remove it.
3.	Image Enhancement: Remove motion blur.
4.	Perform Digital Image water marking.
5.	Morphological Operations: Gray image Erosion & Dilation.
6.	Morphological Processing: Boundary Extraction, Object Identification.
7.	Segmentation: Split and Merge Algorithms.
8.	Detection of motion by differencing.
9.	Image Segmentation: Hough transform for lines and circles.
10.	Feature Extraction: Texture filters.

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Course	Master of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core course for Computer Science/Telecommunications.	
Prerequisite	3070501-Computer Network	
Course Objective	Learning Computer Network and wireless Network	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	-	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Overview of Wireless Networks and Medium Characteristics** Introduction, Different generations. Introduction to 1G, 2G, 3G and 4G networks Radio propagation mechanism, Path loss modeling, Effects of Multipath and Doppler.	**10**	**15**
2	**Physical Layer and Medium Access Alternatives** Short distance base band transmission, Ultra Wide-Band pulse transmission, Carrier modulated transmission, Digital cellular transmission, Broadband and Spread Spectrum transmission. Diversity and Smart receiving techniques. Fixed assignment access for voice oriented networks, Random access for data oriented networks.	**15**	**25**
3	**Wireless Network Planning and Operation** Wireless network topologies, Cell fundamentals and topologies, Signal to Interference ratio calculation, Capacity expansion techniques. Network planning for CDMA systems. Mobility management, Mobile internet protocols, Radio resources and power management, Security in wireless networks.	**15**	**25**
4	**GSM, TDMA, CDMA technology and Mobile Data networks** Mechanism to support mobile environment, Communication infrastructure. Reference architecture for North American Systems, IS-95, IMT -2000. GPRS and higher data rates, Short messaging services in GSM, Mobile application protocols	**10**	**20**
5	**Wireless Broad band and Ad-hoc networks** IEEE 802.11 WLANs, Ad-Hoc networking, Bluetooth, WPANs, WiMax technology. Wireless Geo location Systems.	**10**	**15**
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Create
Weightage	20	20	20	10	30

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

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Course Outcomes

At the end of this course, students will be able to:	
CO1	Understanding of the fundamental concepts of wireless communication.
CO2	Studying mobile radio system, characteristics of radio waves, Radio propogation, wireless system
CO3	Studying wireless system and wireless data networking
CO4	Analyse basics of mobile network layer and mobile transport layer.
CO5	Analyse security, energy efficiency, mobility, scalability and unique characteristics in Wireless Communication Network.
CO6	Demonstrate basic skills for cellular network design.

Reference Books

1.	**Wireless Communications and Networks : 3G and beyond (TextBook)** By Iti Saha Misra | Tata McGraw Hill
2.	**Mobile Computing Technology : Application and Service Creation (TextBook)** By Asoke K Talukder Roopa R Yavagal | Tata McGraw Hill
3.	**Wireless Communications : Principles and Practice** By Theodore S. Rappaport | Pearson

List of Practical

1.	Setup & Configuration of Wireless Access Point (AP)
2.	Study of WLAN: Ad Hoc & Infrastructure Mode
3.	Study of Bluetooth Protocol and Applications
4.	GSM modem study (Nokia 30) and SMS client-server application
5.	Mobile Internet and WML
6.	J2ME Program for Mobile Node Discovery
7.	Mobile protocol study using omnet++
8.	Wireless Network Security: kismet and Netstumbler

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Course	Master of Technology (M.Tech.)	**Semester - 2**
Type of Course	Core course for Computer Science/Software Engineering.	
Prerequisite	3070701- Compiler Design	
Course Objective	To provide a comprehensive understanding of language translation mechanisms, including lexical analysis, syntax analysis,	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks			
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**	**LAB**	**Total Marks**
3	-	2	4	70	30	50	150

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Language Translation Overview** • Overview of system software used during translation. • Language processors, linker, loader, Types of language processors –assembler, interpreter, compiler. Difference between interpreter, assembler and compiler. • Overview and use of linker and loader, Static linking, dynamic linking, Types of Loader, model of compilation, • The Phases of a Compiler, Grouping of Phases, Compiler-Construction Tools, Complier Design Issues	**10**	**15**
2	**Lexical Analysis and Syntax Analysis** • The Role of the Lexical Analyser, regular expression, regular languages, Input Buffering, Specification of Lexemes, Tokens and pattern. • Recognition of Tokens, A Language for Specifying Lexical Analysers, Finite Automata, From a Regular Expression to an NFA, Design of a Lexical Analyser Generator, Optimization of DFA-Based Pattern Matchers. • The Role of the Parser, Context-Free Grammars, Writing a Grammar. • Top-Down Parsing, Bottom-Up Parsing, Operator-Precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.	**15**	**25**
3	**Syntax-Directed Translation, Memory Allocation , Organization And Memory Management** • Syntax-Directed Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S-Attributed Definitions, L-Attributed Definitions, Top Down Translation, Bottom-Up Evaluation of Inherited Attributes, Recursive Evaluators, Analysis of Syntax-Directed Definitions. • Type Systems, Specification of a Simple Type Checker, Equivalence of Type Expressions, Type Conversions, Overloading of Functions and Operators. • Source Language Issues, Storage Organization, Storage Allocation Strategies, and Access to Non local Names, Parameter Passing, and Language Facilities for Dynamic Storage Allocation, Dynamic Storage Allocation Techniques. • Activation Tree, Activation Record, Parameter Passing, Symbol Table, Static, Dynamic And Heap Storage Allocation, Garbage Collection.	**15**	**20**
4	**Intermediate Code Generation, Code Optimization**	**10**	**20**

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	• Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls, Types of Intermediate Forms of the Program. • The Principal Sources of Optimization, Optimization of Basic Blocks, Loops in Flow Graphs. • Introduction to Global Data-Flow Analysis, Iterative Solution of Data-Flow Equations, Linear optimization (peep hole) Techniques, parse optimization Techniques and structured optimization techniques. • Code-Improving Transformations, Dealing with Aliases, Data-Flow Analysis of Structured Flow Graphs, Efficient Data-Flow Algorithms, A Tool for Data-Flow Analysis, Estimation of Types, Symbolic Debugging of Optimized Code.		
5	**Code Generation and Symbol Table Management**	**10**	**20**

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Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
	• Issues in the Design of a Code Generator, The Target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, A Simple Code Generator, Register Allocation and Assignment. • The DAG Representation of Basic Blocks, Peephole Optimization, Generating Code from DAGs, Dynamic Programming Code-Generation Algorithm, Code-Generator Generators. • General concepts of STM, Symbol Table as a data structure, Various operations performed on Symbol Table, Symbol table organizations for blocked structured language and non-blocked structured language.		
	Total	**60**	**100**

Suggested Distribution Of Theory Marks Using Bloom's Taxonomy

Level	Remembrance	Understanding	Application	Analyze	Evaluate	Create
Weightage	30	10	10	30	10	10

NOTE : This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes

At the end of this course, students will be able to:	
CO1	Understand the basic concepts and application of Compiler Design.
CO2	Understand backend of compiler: intermediate code, Code optimization Techniques and Error Recovery mechanisms
CO3	Apply basic knowledge Data Structure to design Symbol Table, Lexical Analyzer, Intermediate Code Generation and Parser.
CO4	Understand strength of Grammar and Programming Language

Reference Books

1.	**Advanced compiler Design** By Steven S. Muchnick | Morgan Kaufmann
2.	**Compiler Design (TextBook)** By A. A. Puntambekar | Technical Publications
3.	**Principles of Compiler Design (TextBook)** By V. Raghavan | McGrawHill
4.	**Compilers Principles, Techniques and Tools (TextBook)** By Alfred Aho, Ravi Sethi, Jeffrey D Ullman | Pearson Education Asia

List of Practical

1.	Write a program to specify the tokens from given string and recognize it as a valid variable name. Once a variable is valid scan variable values and evaluate expression.
2.	Write a program to implement lexical analyzer.
3.	Write a program to check weather expression is valid or invalid.
4.	Write a program to find First() set from given grammar.
5.	Write a program to find Follow() set from given grammar.
6.	Write a program to remove the Left Recursion from a given grammar
7.	Write a program to remove left factoring.
8.	Write a program to check whether a string belongs to given grammar or not.

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Course	Master of Technology (M.Tech.)	**Semester - 3**
Type of Course	Core Subject	
Prerequisite	3080504- Web Development	
Course Objective	Knowledge of Semantic Web standards and protocols, including SPARQL for querying RDF data	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks		**LAB**	
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**		**Total Marks**
3	0	0	3	70	30	0	100

SEE *- Semester End Examination,* ***CIA*** *- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Introduction and Vision** Modern Web, Introduction to Ontologies, Ontology languages for Semantic Web, Semantic web technologies, Layered approach, Applications of Semantic Web Technologies.	15	25
2	**Structured Web Documents & Web Resources:** XML, RDF: The XML language, Structuring, Namespaces, Querying and Addressing XML documents, Processing, Introduction, RDF , RDF Schema syntax and language, Direct Inference System, Querying RQL	15	20
3	**Web Ontology Language, Knowledge Representation.** Introduction, OWL language, Examples, Knowledge Representation: Languages - Formalisms, Logics - Semantic Networks, Frame- Based KR, and Description Logics, Future extensions.	10	20
4	**Discovering Information** Introduction, Querying, Monotonic Rules syntax, semantics & examples, Non-monotonic rules – syntax & examples, Encoding in XML	10	15
5	**Semantic Web Applications & Case Studies** Description Logic, e-Learning, Web Services, Building Semantic Web Applications, Other Scenarios.	10	20
	Total	60	100

Course Outcomes

At the end of this course, students will be able to:	
CO1	Ability to understand and apply the principles and technologies of the Semantic Web.
CO2	Proficiency in creating and querying RDF (Resource Description Framework) data.
CO3	Skill in using ontology languages such as OWL (Web Ontology Language) for knowledge representation.
CO4	Knowledge of Semantic Web standards and protocols, including SPARQL for querying RDF data
CO5	Ability to develop and integrate semantic web applications for improved data interoperability and knowledge discovery.

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Reference Books	
1.	**A Semantic web Primer (TextBook)** By Grigoris Antoniou and Frank Van Hermelen | MIT Press
2.	**Foundations of Semantic Web Technologies** By Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, | CRC Press
3.	**Semantic Web programming (TextBook)** By John Hebleret.el | Wiley

List of Practical	
1.	Create an XML file defining an article in newspaper.
2.	Create an XML file containing list of students. Also create stylesheet file to display list in an HTML format.
3.	Create an XML file containing list of students. Using XPath display following information Information of a student with ID No : 1. The entire student in the sorted order according to their CGPA.
4.	Study of RDF (Resource Description Framework)
5.	Prepare case study for Semantic Web Applications.

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Course	Master of Technology (M.Tech.)	**Semester - 3**
Type of Course	Practical implementation of research	
Prerequisite	Basics of research Skills, Software Computing	
Course Objective	**Research Methodology:** Design and detail research methods, including sampling and analysis. **Data Collection:** Collect data ethically and effectively, addressing challenges. **Preliminary Analysis:** Analyze data to identify trends and guide further research.	

Teaching Scheme (Contact Hours)				**Assessment Scheme**			
				Theory Marks		**LAB**	
Lecture	**Tutorial**	**Lab**	**Credit**	**SEE**	**CIA**		**Total Marks**
-	-	-	10	-	-	300	300

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	**Topics**	**T**	**W**
1	**Dissertation Phase-1 Guidelines To remember**		100

1. Literature Review:

- **Objective:** Develop a comprehensive understanding of existing research related to your topic.
- **Content:** Summarize key theories, models, and findings; identify gaps in the current knowledge base.
- **Structure:** Introduction, thematic or chronological review, critical analysis, conclusion.

2. Problem Formulation:

- **Objective:** Clearly define the research problem or question.
- **Content:** Statement of the problem, justification of significance, specific research questions or hypotheses.
- **Structure:** Background, problem statement, importance, research questions or hypotheses.

3. Progress:

- **Objective:** Document work completed so far.
- **Content:** Summary of completed activities, key findings, challenges encountered.
- **Structure:** Introduction, description of tasks, results and findings, discussion of challenges.

4. Work Plan:

- **Objective:** Outline the remaining work and timeline.
- **Content:** Detailed plan for remaining tasks, milestones, deadlines, required resources.
- **Structure:** Introduction, list of tasks with deadlines, timeline (e.g., Gantt chart), required resources.

Formatting and Submission Requirements:

- **Format:** Follow institutional guidelines (font, spacing, margins, etc.).
- **Length:** Ensure sections are thorough but concise.
- **References:** Properly cite all sources.
- **Submission:** Submit by the specified deadline for review.

Total		100%

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Course	Master of Technology (M.Tech.)	**Semester - 4**
Type of Course	Practical Subject	
Prerequisite	Dissertation Phase -I	
Course Objective	**Research Methodology:** Design and detail research methods, including sampling and analysis. **Data Collection:** Collect data ethically and effectively, addressing challenges. **Preliminary Analysis:** Analyze data to identify trends and guide further research.	

Teaching Scheme (Contact Hours)				Assessment Scheme			
				Theory Marks		LAB	
Lecture	Tutorial	Lab	Credit	SEE	CIA		Total Marks
-	-	-	20	-	-	400	400

***SEE** - Semester End Examination, **CIA** - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)*

Course Content

T - Teaching Hours | **W** - Weightage

Sr.	Topics	T	W
1	**Guidelines For Phase-II**		**100**

1. Research Methodology:

- **Objective:** Detail the research design and methods used to address the research problem.
- **Content:**
  - Research design (e.g., qualitative, quantitative, mixed methods)
  - Sampling methods and sample size
  - Data collection techniques (e.g., surveys, interviews, experiments)
  - Tools and instruments used (e.g., questionnaires, software)
  - Data analysis methods (e.g., statistical analysis, thematic analysis)

2. Data Collection:

- **Objective:** Collect data relevant to the research problem using the outlined methods.
- **Content:**
  - Description of the data collection process
  - Instruments and tools used
  - Challenges and how they were addressed
  - Ethical considerations

3. Preliminary Analysis:

- **Objective:** Conduct an initial analysis of the collected data to identify trends, patterns, and insights.
- **Content:**
  - Data cleaning and preparation
  - Initial statistical or thematic analysis
  - Key findings and observations
  - Interpretation of preliminary results

4 Formatting and Submission Requirements:

- **Format:** Follow institutional guidelines (font, spacing, margins, etc.).
- **Length:** Ensure sections are thorough but concise.
- **References:** Properly cite all sources.
- **Submission:** Submit by the specified deadline for review.

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Total		**100**

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