MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)
#14, Ramohalli Cross, Kumbalagodu, Mysore Road, Bengaluru–560074



M.Tech - Computer Science and Engineering

M.Tech - Computer Science and Engineering (AIML)

I Semester Scheme and Syllabus

(2026 Scheme)

VISION

To empower young minds through technology, research and innovation, to produce technically competent and socially responsible professionals in higher education.

MISSION

1. To deliver excellence in education through innovative teaching, impactful research, and continuous skill development, preparing students to meet global challenges with technical expertise and ethical responsibility.
2. To foster a transformative learning environment that integrates technology, research and practical experience, empowering students to become skilled professionals and socially conscious leaders.
3. To cultivate a culture of lifelong learning and professional excellence by encouraging creativity, research, and community engagement, equipping students with the skills to thrive in a dynamic world.
4. To provide a holistic educational experience that combines advanced technology, hands-on research, and community-focused learning, shaping students into competent, ethical professionals who contribute positively to society.

QUALITY POLICY

Rajarajeswari College of Engineering is committed to imparting quality technical education that nurtures competent, ethical professionals with global relevance. We ensure academic excellence through a dynamic, outcome-based curriculum, experienced faculty, and cutting-edge infrastructure. Continuous improvement is driven by innovation, research and strong industry collaboration. We foster holistic development and a progressive environment that supports lifelong learning, teamwork, and professional growth.

CORE VALUES

Academic Excellence, Integrity, Innovation, Global Competence, Continuous Improvement.

Computer Science and Engineering

DEPARTMENT VISION

To produce competent professionals who drive research, foster innovation, and develop technologies that address global challenges and inspire future generations.

DEPARTMENT MISSION

1. Provide extensive technical education to produce trained professionals and entrepreneurs.
2. Establish a knowledge environment for progressive research by imparting industrial-based skill development courses on the growth of a modernized environment.
3. Create and develop innovative skills by collaborating with Industries to generate solutions for societal impact with moral standards.
4. To instill lifelong learning, adaptability, and resilience, equipping students to thrive in fast-evolving fields and continuously advance technology.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems /components / processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

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MOOGAMBIGAI CHARITABLE AND EDUCATIONAL TRUST

Rajarajeswari College of Engineering

(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

M. Tech in Computer Science & Engineering

Scheme of Teaching and Examinations – 2026 Scheme

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

I Semester **Common to CSE, CSE (AIML)** **Academic Year: 2026-27**

S. No	Course Category and Course Code		Course Title	TD / PSB	Teaching Hours / Semester					Examination				Credits
					Lecture	Tutorial	Practical	TW + SL	Total Hours / Sem	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S						
1	ASC	P26MCS101	Advanced Mathematics	Maths	28	28	0	34	90	3	50	50	100	3
2	PCC	P26MCS102	Advanced Data Structures and Applications	CSE	42	0	0	48	90	3	50	50	100	3
3	PCC	P26MCS103	Data Science and Management	CSE	42	0	0	48	90	3	50	50	100	3
4	IPCC	P26MCS104	Advanced Database Management Systems	CSE	42	0	28	50	120	3	50	50	100	4
5	PEC	P26MCS105	Artificial Intelligence for IoT	CSE	42	0	0	48	90	3	50	50	100	3
6	PEC	P26MCS106	Software Engineering and Web Applications	CSE	42	0	0	48	90	3	50	50	100	3
7	PCCL	P26MCSL107	Advanced Data Structures Laboratory	CSE	0	0	28	02	30	3	50	50	100	1
TOTAL									600	-	350	350	700	20
8	NCMC	P26MCS108	Research Methodology and IPR (Online)	ONLINE COURSES (Online.vtu.ac.in)										PP

Note: PCC: Professional core course. IPCC-Integrated Professional Core Courses, PCCL-Professional Core Course lab, PEC: Professional Core Course, L-Lecture, T/SDA-Tutorial / Skill Development Activities, P-Practical (Hours are for Interaction between faculty and students)

HOD **Dean-Academics** **Principal**

Semester-I					
Advanced Mathematics **Category: ASC**					
Course Code	:	**P26MCS101**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	28:28:0:34	SEE	:	50Marks
Total Hours / Semester	:	90	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objectives is	
1.	To develop students understanding of inner product space concepts, matrix factorization, applications of linear models.
2.	To develop students skills in data analysis using correlation, curve fitting, regression models, and maximum likelihood estimation to interpret relationships among variables.
3.	To develop students' ability to formulate mathematical optimization problems.
4.	To formulate and solve constrained optimization problems using appropriate mathematical techniques for engineering and computational applications.

Module - 1	**No. of Hours.**
Orthogonality and least squares: Inner product, orthogonal sets, orthogonal projections, orthogonal bases. Gram-Schmidt orthogonalization process. QR factorizations of matrices, least square problems, applications to linear models (least square lines and least square fitting of other curves).	09
Module - 2	**No. of Hours.**
Symmetric and Quadratic Forms: Diagonalization, Quadratic forms, Canonical Forms, The Singular value decomposition. Applications for image processing and statistics, Principal Component Analysis	09
Module - 3	**No. of Hours.**
Correlation, Regression Analysis, Curve fitting (Linear and Non-linear), Simple linear regression, Multiple linear regression, Multivariate regression analysis, Logistic regression, Maximum Likelihood Method.	08
Module - 4	**No. of Hours.**
Function of several variables, partial differentiation, local and global optima, convex sets and functions separating hyperplanes, application of Hessian matrix in optimization. Optimization using gradient descent method and NR method and Fibonacci search.	08
Module - 5	**No. of Hours.**
Problem Formulation, Minimax Algorithms applications of unconstrained optimization, Point Pattern Matching, Concept of Lagrangian multiplier, Kuhn Tucker conditions (KKT), Method of Multipliers, Penalty Function, Complex search method, Interior Point Methods for Large-scale Optimization.	08

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply inner product space concepts, matrix factorization techniques, least-squares methods, quadratic forms, singular value decomposition, and principal component analysis to solve mathematical and data-driven problems.
CO2	Analyse data using correlation, curve fitting, regression models, and maximum likelihood methods to interpret relationships among variables and develop suitable predictive models.
CO3	Apply unconstrained optimization techniques to formulate and solve optimization problems.
CO4	Apply constrained optimization techniques to solve optimization problems arising in engineering and computational applications.

Text Books	
1.	Stephen Boyd and Lieven Vandenberghe, Convex Optimization" by , 1st Edition,Cambridge University Press, 2004.
2.	Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal, Springer, 2020
3.	Linear Algebra and its applications, David C. Lay, Steven R. Lay, Judi J Mc. Donald, 5th Edition, 2021, Pearson Education.
4.	Introduction to Linear Regression Analysis by Douglas C. Montgomery, Elizabeth A.Peck, G. Geoffrey Vining (Wiley), 6th Edition, 2024.

Reference Text Books	
1.	S. S. Rao, Engineering Optimisation: Theory and Practice, Wiley, 2008.
2.	K. Deb, Optimization for Engineering design algorithms and Examples, Prentice Hall,2nd edition 2012.
3.	Jorge Nocedal and Stephen J. Wright, Numerical Optimization, 2nd Edition, Springer,2006.
4.	Linear Algebra: An Introduction, Richard Bronson & Gabriel B. Costa, 2nd edition,Academic press.

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 50% of 50 marks, i.e., 25 marks. To pass the SEE, a student must score at least 40% of 50 marks, i.e., 20 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 50 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	40 (Average of Best two Assessments)	50
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	-	2
CO2	2	2	-	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	-	-	-	-	-	2
CO4	2	3	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

Semester-I					
Advanced Data Structures and Applications **Category: PCC**					
Course Code	:	**P26MCS102**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	42:0:0:48	SEE	:	50Marks
Total Hours / Semester	:	90	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objectives	
1.	To explain the heap structures, priority queues, and hashing techniques.
2.	To explore the advanced hashing techniques and priority queue structures for efficient data management.
3.	To understand balanced trees and mergeable heaps for efficient data organization and operations.
4.	To explain the adaptive search trees, multiway trees, and trie structures for efficient searching and data organization.
5.	To explore augmented and specialized data structures for efficient searching, indexing, and data management.

Module - 1	**No. of Hours.**
Fundamental Heap Structures and Hashing: Heap Structures: Heaps, Maintaining the Heap Property, Building a Heap, Priority Queues. Hashing Fundamentals: Direct Address Tables, Hash Tables, and Hash Functions.	09
Module - 2	**No .of Hours.**
Advanced Hashing and Priority Structures: Advanced Hashing: Open Addressing, Perfect Hashing. Dynamic Hashing: Dynamic Hashing, Bloom Filters. Advanced Priority Structures: Pairing Heap, Symmetric Min-Max Heaps, and Interval Heaps.	09
Module - 3	**No. of Hours.**
Balanced Trees and Mergeable Heap Structures: Red-Black Trees: Properties of Red-Black Trees, Rotations, Insertion, Deletion. Mergeable Heap Structures: Leftist Trees, Binomial Heaps, Fibonacci Heaps.	08
Module - 4	**No. of Hours.**
Search Trees and Trie Structures: and Multiway Search Trees: Splay Trees, m-Way Search Trees, B-Trees, B+ Trees. Trie Structures: Digital Search Trees, Binary Tries and Patricia Trees, Multiway Tries.	08
Module - 5	**No. of Hours.**
Augmented and Specialized Structures: Augmented Data Structures: Dynamic Order Statistics, How to Augment a Data Structure, Interval Trees. Applied Trie Structures: Suffix Trees, Tries in Internet Packet Forwarding.	08

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain heap and priority queue structures, and hashing techniques.
CO2	Construct balanced and multiway search trees for efficient data storage.
CO3	Apply tries and augmented structures for fast data retrieval.
CO4	Apply advanced data structures to solve real-world data problems.
CO5	Explain heap and priority queue structures, and hashing techniques.

Text Books	
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, Introduction to Algorithms, 4th Edition, (2022), MIT Press.
2.	Ellis Horowitz and SartajSahni, Fundamentals of Data Structures in C, 2nd Edition (2023), Universities Press(India) Private limited.

Reference Text Books	
1.	Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, 4th Edition, (2014) Pearson Education.
2.	SartajSahni, Data Structures, Algorithms and Applications in C++, 2nd Edition, (2011), Universities Press.
3.	Peter Brass, Advanced Data Structures, 1st Edition, (2011), Cambridge University Press.

Web links and Video Lectures (e-Resources):

- NPTEL – Advanced Data Structures:https://nptel.ac.in/courses/106102064
- MIT OpenCourseWare – Advanced Data Structures:https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/
- Visualgo – Interactive Data Structure Visualizations: https://visualgo.net/en

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 50% of 50 marks, i.e., 25 marks. To pass the SEE, a student must score at least 40% of 50 marks, i.e., 20 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 50 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	**Type of Assessment**	**Max. Marks**	**Max. Marks Scaling Down to**	**Total Marks**
Theory	**Internal Assessment-1**	**50**	**40** (Average of Best two Assessments)	**50**
	Internal Assessment-2	**50**		
	Internal Assessment-3	**50**		
AAT	**Any Two Assessments as per regulations**	**20**	**10**	
SEE	**Semester End Examination**	**100**	**50**	**50**
Total Marks				**100**

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Semester-I					
Data Science and Management **Category: PCC**					
Course Code	:	**P26MCS103**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	42:0:0:48	SEE	:	50Marks
Total Hours / Semester	:	90	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand data science, analytics processes, and data-driven decision-making for solving business problems.
2.	To apply statistical and predictive analytics for effective decision-making.
3.	To understand AI and intelligent decision systems for analytics, automation, and optimization.
4.	To understand big data governance, ethical analytics, privacy, security, and responsible AI practices.
5.	To apply data science strategies and analytics for industrial decision-making and business growth.

Module -1	**No. of Hours.**
Foundations of Data Science and Analytics: Data-Analytic Thinking, Data Science Engineering Data-Driven Decision Making, Business Problems and Data Science Solutions, Data Mining Process, Business Intelligence and Analytics, Analytics Ecosystem, Applications of Analytics.	08
Module - 2	**No. of Hours.**
Predictive Analytics and Decision Support: Nature of Data, Data Sources, Statistical Analysis, Descriptive Analytics, Data Visualization for Decision Making, Dashboard Concepts, Predictive Modeling, Model Evaluation and Cost-Benefit Analysis.	09
Module - 3	**No. of Hours.**
Artificial Intelligence and Intelligent Decision Systems: Artificial Intelligence Foundations, AI and Analytics, Intelligent Systems, Text Analytics, Web Analytics, Social Media Analytics, Prescriptive Analytics, Decision Automation and Optimization.	08
Module - 4	**No. of Hours.**
Data Governance, Ethics and Responsible AI: Big Data Concepts, Big Data Ecosystem, Big Data Applications, Privacy Challenges, Security Concerns, Ethical Issues in Analytics, Responsible AI, Future Challenges in AI Governance.	08
Module - 5	**No. of Hours.**
Data Science Strategy and Industrial Applications: Decision Analysis, Analytic Engineering, Deployment of Analytics, Data Science and Business Strategy, Competitive Advantage through Analytics, Data Science Teams, Organizational Adoption of Analytics, Industrial Case Studies in Healthcare, Manufacturing, Finance, and Transportation. Interval Trees.	09

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the principles of data science, analytics, artificial intelligence, data governance, and their role in data-driven decision making.
CO2	Apply statistical analysis, visualization, predictive analytics, AI techniques, and business analytics tools to solve real-world data-driven problems.
CO3	Analyze business problems using predictive, prescriptive, text, web, and social media analytics to support intelligent decision making.
CO4	Evaluate analytical solutions considering business objectives, ethical issues, privacy, security, responsible AI, and governance principles.
CO5	Design and develop an end-to-end analytics solution for an industrial application by integrating data science methodologies, AI techniques, governance practices, and business strategy.

Text Books	
1.	Foster Provost and Tom Fawcett, Data Science for Business: What You Need to Know About Data M Analytic Thinking, 2nd Edition, O'Reilly Media, USA, 2023.
2.	Ramesh Sharda, DursunDelen and Efraim Turban Business Analytics, Data Science and AI: A Managerial Approach, 6th Edition, Pearson Education, 2026.

Reference Text Books	
1.	Thomas H. Davenport and Jeanne G. Harris, Competing on Analytics: The New Science of Winning, Updated Edition, Harvard Business Review Press, 2017.
2.	Thomas H. Davenport, Jeanne G. Harris and Robert Morison, Analytics at Work: Smarter Decisions, Better Results, Harvard Business Review Press.
3.	Bernard Marr, Data Strategy: How to Profit from a World of Big Data, Analytics and Artificial Intelligence, 2nd Edition, Kogan Page, 2022.
4.	S. Christian Albright and Wayne L. Winston, Business Analytics: Data Analysis and Decision Making, 8th Edition, Cengage Learning, 2024.

Web links and Video Lectures (e-Resources):

- Google Data Analytics: https://grow.google/intl/en_in/data-analytics-course/
- Elements of AI: https://course.elementsofai.com/?utm_source=chatgpt.com
- Data Science: https://skillsbuild.org/students/course-catalog/data-science?utm_source=chatgpt.com
- Data Science: https://www.datadays.org/?utm_source=chatgpt.com

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CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	40 (Average of Best two Assessments)	50
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				**100**

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Semester-I					
Advanced Database Management Systems **Category: I PCC**					
Course Code	:	**P26MCS104**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	42:0:28:50	SEE	:	50Marks
Total Hours / Semester	:	120	Total	:	100Marks
Credits	:	4	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand relational constraints and object-relational database concepts, including ODL, OQL, and database design.
2.	Discuss the disk storage, file organization, hashing, RAID, and distributed database management techniques.
3.	To understand NoSQL databases, big data storage, and Hadoop-based Map Reduce technologies.
4.	To explore enhanced data models and information retrieval techniques for efficient data processing and web search.
5.	To explore data mining techniques and data warehousing concepts for effective data analysis and decision-making.

Module - 1	**No .of Hours.**
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, dealing with constraint violations. **Object and Object-Relational Databases:** Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.	08
Module - 2	**No. of Hours.**
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files), Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. **Distributed Database Concepts**: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalogue Management.	09
Module - 3	**No. of Hours.**
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document-Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. **Big Data Technologies Based on Map Reduce and Hadoop**: What Is Big Data? Introduction to Map Reduce and Hadoop, Hadoop Distributed File System (HDFS), Map Reduce: Additional Details Hadoop v2 alias YARN, General Discussion.	09

Module – 4	**No .of Hours.**
Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases: Active Database Concepts and Triggers, Temporal Database Concepts, Spatial Database Concepts, Multimedia Database Concepts, **Introduction to Deductive Databases. Introduction to Information Retrieval and Web Search**: Information Retrieval (IR) Concepts, Retrieval Models, Types of Queries in IR Systems, Text pre-processing, Inverted Indexing, Evaluation Measures of Search relevance, web Search and Analysis. Trends in Information Retrieval.	08
Module - 5	**No. of Hours.**
Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, Approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools **Overview of Data Warehousing and OLAP**: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modelling for Data Warehouses, building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.	08

List of Experiments

SQL QUERIES (Based on DDL statement, Constraints, DML statement, SELECT statement and Views)

Note: In all schemas, create the table with necessary constraints (PK, FK, Not Null, Unique and Check Constraints) on SQL prompt and then solve the given queries.

1. SQL Practical List:

CUST (Custno, Custname, Addln1, Addln2, City, State, Phone)
ITEM (Itemno, Itemname, Itemprice, Qty_On_Hand)
INVOICE (Invno, Invdate, Custno)
INV_ITEM (Invno, Itemno, Qty_Used)

Create the above four tables along with key constraints. Write an Insert script for insertion of rows with substitution variables and insert Appropriate data.

1. Add a column – "colour" to the Item table.
2. Display the column Item name and Price in sentence form using concatenation.
3. Find the total value of each item (item price * qty).
4. Display the list of customers belonging to "Gujarat" state.
5. Find the customers from "Lalbaug" city of Ahmedabad and Baroda.
6. Find the total, average, highest and lowest unit price of an item.

2.HOSTEL (Hno, Hname, Haddress, Total_Capacity, Warden_Nm)
ROOM (Hno, Rno, Rtype, Location, No_Of_Students, Status)
CHARGES (Hno, Rtype, Charges)
STUDENT (Sid, Sname, Saddr, Faculty, Dept, Class, Hno, Rno)
FEES (Sid, Fdate, Famount)

The STATUS field tells us whether the room is occupied or vacant. The charges represent the term fees to be paid half yearly. A student can pay either the annual fees at one time or the half yearly fees twice a year.
Create the above five tables along with key constraints. Write an Insert script for insertion of rows with substitution variables and insert appropriate data.

1. Display the total number of rooms that are presently vacant.
2. Display the number of students who are staying in 'double' seated room for Each hostel.

3. Display the warden's name and hostel address of students of 'Computer Science' Department.
4. Count the total number of 'medical' students who live in the hostel.
5. Display details about students who have paid the fees in the month of November 2011.

3. PUBLISHER (publ_id, publ_name, contact_person, contact_addr contact phone)
CATEGORY (cat_id, cat_details, max_books, duration)
BOOK_MASTER (book_id, bname, isbn_no, total_copies, publ_id)
MEMBER (member_id, mname, cat_id, mem_ship_dt)
ISSUE (ISSUE_id, member_id, book_id, issu_ret, issue_ret_dt)
In the above tables, duration is in years and it stores the membership duration for that category.

1. Change the table design of ISSUE table to add a constraint, which will allow only 'I' or 'R' to be entered in the ISSUE_RETcolumn, which stores the action whether the book is being issued or returned.
2. Add a column to the MEMBER table, which will allow us to store the address of the member.
3. Create a table LIBRARY_USERS which has a structure similar to that of the MEMBER table but with no records.
4. Give details about members who have issued books, which contain the word 'DATA' somewhere in their titles.
5. Display the details of books whose all copies are issued.

4. APPLICANT (aid, aname, addr, abirth_dt)
ENTRANCE_TEST (etid, etname, max_score, cut_score)
ETEST_CENTRE (etcid, location, incharge, capacity)
ETEST_DETAILS (aid, etid, etcid, etest_dt, score)
This database is for a common entrance test which can be conducted at a number of centers and can be taken by an applicant on any day except holidays.

1. Modify the APPLICANT table so that every applicant id has an 'A' before its value.
   For example, if the applicant id '1123', it should now become 'A1123'.
2. Display the test centre details where no tests will be conducted.
3. Display the details about applicants who have the same score as that of "Jaydev" in "Oracle Fundamentals".
4. Display the details of applicants who have appeared for all the tests.
5. Display those tests where no applicant has failed.
6. Display details of entrance test centres which had full attendance between 1st November and 15th November 2011.

5. Consider the relational schema and write down the relational algebra for the following
STUDENTS(Student_ID, Student_Name, Class, Major)
COURSE(CourseNo, CourseName, Cr_Hr, Dept)
SECTION(Sect_ID, CourseNo, Semester, Year, Instructor_Name)
GRADEREPORT(Student_ID, Sect_ID, Grade)
PREREQUISITE(CourseNo, Prerequisite_Course)

1. Create a database named "labworkquestion1" and create the tables mentioned above.
2. Insert 5 rows into each table.
3. Display the name and major of all students whose grade is "A".
4. Delete all tuples in the section relation whose instructor is Mr. Bean.
5. Find the number of students in each class.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Design advanced relational and object-relational databases with strict integrity constraints.
CO2	Design and optimize high-performance data architectures by utilizing advanced file Structures, hashing, RAID systems, and distributed database techniques.
CO3	Implement scalable Big Data solutions using diverse NoSQL architectures, Hadoop Ecosystem, Map Reduce frameworks, and distributed storage systems.
CO4	Build enhanced data models and information retrieval strategies to optimize advanced web search systems.
CO5	Design data warehouses and apply data mining algorithms to extract actionable business Intelligence patterns.

Text Books	
1.	Fundamentals of Database Systems, RamezElmasri and Shamkant B. Navathe, 7th Edition, Pearson Education, 2016.

Reference Text Books	
1.	Database System Concepts Author: Abraham Silberschatz, Henry F. Korth, and S. Sudarshan Publisher: McGraw-Hill Year of Publication: March 2022 (7th Edition) ISBN: 9780078022159
2.	Advanced Database Management System Author: Dr. Sanjeev Sharma Publisher: Wiley India Year of Publication: 2024 ISBN: 9789351199380.
3.	Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke, McGraw Hill, 3rd edition, 2013.

Web links and Video Lectures (e-Resources):

- https://www.geeksforgeeks.org/dbms/definition-and-overview-of-odbms/
- https://www.mongodb.com/resources/basics/databases/distributed-database
- https://www.geeksforgeeks.org/introduction-to-nosql/
- https://www.geeksforgeeks.org/dbms/rdms-vs-hadoop/
- https://www.datacamp.com/tutorial/dbms-data-models-explained

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 50% of 50 marks, i.e., 25 marks. To pass the SEE, a student must score at least 40% of 50 marks, i.e., 20 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 50 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	40 (Average of Best two Assessments)	50/2 = 25
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Any One Assessment as per Regulations	10	10	
Laboratory	Lab Conduction & Record	Evaluating each expt. for 10 marks.	10	25
	Lab Internal Test	50	15	
SEE	Semester End Examination	100	50	50
Grand Total				100

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Semester-I					
Artificial Intelligence for IoT **Category: PEC**					
Course Code	:	**P26MCS105**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	42:0:0:48	SEE	:	50Marks
Total Hours / Semester	:	90	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To develop skills in IoT and AI integration, applying machine learning algorithms for prediction, classification, and intelligent IoT applications.
2.	To develop skills in IoT and AI integration, applying machine learning algorithms for prediction, classification, and intelligent IoT applications.
3.	To develop skills in cloud-based AI services and deep learning techniques for analyzing time-series IoT data and deploying intelligent IoT solutions across diverse domains.
4.	To apply AI techniques, including computer vision, natural language processing, and audio analytics, to develop intelligent IoT solutions using diverse data sources.
5.	To explore AI and IoT applications in personal, home, and smart city environments, focusing on intelligent automation, urban analytics, and real-world case studies.

Module -1	**No. of Hours.**
Foundations and Basic Integrations of IoT and AI **Principles and Foundations of IoT and AI:** What is IoT ? Big data and IoT, Infusion of AI data science in IoT, Tools used. **Machine Learning for IoT:** Understanding ML and its Role in IoT, Learning paradigms, Prediction using linear regression, Logistic regression for classification, Classification using support vector machines, Naive Bayes, Decision trees, Ensemble learning.	09
Module - 2	**No. of Hours.**
Advanced AI Techniques and Their Application in IoT **Deep Learning for IoT:** Deep learning 101, Multilayered perceptron for regression and classification, Understanding CNNs, Recurrent neural networks. **Reinforcement Learning for IoT**: Introduction to RL, Simulated environments, Introducing Gymnasium, Q-learning, Q-Network.	08
Module - 3	**No. of Hours.**
Implementing Intelligent IOT Solutions in Diverse Domains-1 **AI Cloud Platforms for IoT:** Introduction to Cloud Computing for IoT, Cloud Computing Basics, AI Services in Cloud Platforms, Training and Deploying AI Models for IoT on Cloud Platforms **Deep Learning for Time-Series Data from IoT**: Introduction to Time-Series Data, The Importance of Time-Series Analysis in IoT,	08
Module - 4	**No .of Hours.**
Implementing Intelligent IOT Solutions in Diverse Domains-2 **Leveraging AI for Visual Data from IoT:** A Brief Introduction to Visual Data in IoT Ecosystems, Handling Challenges in Visual Data in IoT, Leveraging AI Techniques for Visual Data in IoT. **AI for Text, Audio and Speech Data from IoT**: Introduction to Text, Audio, and Speech Data, Fundamentals of Text Data Processing, Working with Audio Data in IoT.	09

Module - 5	No. of Hours.
Applying AI and IoT in Real-World Scenarios **AI for Personal and Home IoT:** Wearable and Fitness Devices, Smartwatch Health Monitoring in Action, Smart Home Devices, AI-driven home automation and intelligence, Case study: An Integrated smart home Implementation **AI for Smart Cities IoT**: AI Applications in Smart Cities: Smart traffic management, Smart parking, Smart waste management, smart policing. AI-Powered Urban Analytics, Adapting IoT for Smart Cities and the Necessary Steps.	08

Course Outcomes: At the end of the course, the students will be able to	
CO1	Explain the fundamental concepts of Artificial Intelligence, Internet of Things (IoT), and their integrati intelligent IoT systems.
CO2	Apply machine learning, deep learning, and reinforcement learning techniques for processing and analyzing IoT-generated data.
CO3	Develop AI-enabled IoT applications using cloud platforms and intelligent data analytics techniques.
CO4	Analyze AI techniques for processing visual, text, audio, speech, and time-series data generated by IoT devices.
CO5	Apply IoT concepts to develop solutions for smart homes, healthcare, smart cities, and industrial automation.

Text Books	
1.	Dr. AmitaKapoor, Hands-On Artificial Intelligence for IoT, 2nd Edition, May 2025, Packt Publishing Ltd., Birmingham, UK, ISBN: 978-1-83546-718-3. www.packtpub.com

Reference Text Books	
1.	Yuxi (Hayden) Liu, Artificial Intelligence for IoT Cookbook, 1st Edition, March 2021, Packt Publishing Ltd., Birmingham, UK, ISBN: 978-1-83898-198-5. www.packtpub.com
2.	RajkumarBuyya and Amir VahidDastjerdi (Editors), Internet of Things: Principles and Paradigms, 1st Edition, May 2016, Morgan Kaufmann (Elsevier), Cambridge, Massachusetts, USA, ISBN: 978-0-12-805395-9
3.	Perry Lea, Internet of Things for Architects: Architecting IoT Solutions by Implementing Sensors, Communication Infrastructure, Edge Computing, Analytics,and Security, 1st Edition, January 2018, Packt Publishing Ltd., Birmingham, UK, ISBN: 978-1-78847-059-9 (Paperback). www.packtpub.com

Web links and Video Lectures (e-Resources):

- NPTEL – Introduction to Internet of Things: https://nptel.ac.in
- NPTEL – Artificial Intelligence and Machine Learning: https://nptel.ac.in
- Google Cloud AI and IoT: https://cloud.google.com
- Coursera – AI and Machine Learning Courses: https://www.coursera.org
- edX – Artificial Intelligence and IoT Courses: https://www.edx.org

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 50% of 50 marks, i.e., 25 marks. To pass the SEE, a student must score at least 40% of 50 marks, i.e., 20 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 50 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	40 (Average of Best two Assessments)	50
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Semester-I					
Software Engineering and Web Applications **Category: PEC**					
Course Code	:	**P26MCS106**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	42:0:0:48	SEE	:	50Marks
Total Hours / Semester	:	90	Total	:	100Marks
Credits	:	3	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To understand software architecture, reusable components, architectural patterns, and service-oriented approaches for developing scalable software systems.
2.	To develop an understanding of reliable and secure software systems, fault tolerance, security requirements, reliability assessment, and security assurance techniques.
3.	To understand software evolution, maintenance, quality assurance, measurement, configuration, version control, change management, and release processes.
4.	To develop skills in analyzing, structuring, modeling, and designing user-friendly, responsive, and effective web applications.
5.	To develop skills in building, integrating, testing, securing, deploying, and maintaining reliable web applications.

Module - 1	**No. of Hours.**
Software Architecture and Reuse Engineering: Architectural Design – Architectural Design Decisions, Architectural Views, Architectural Patterns, Application Architectures, Component-Based Software Engineering – Components and Component Models, CBSE Process, Component Composition, Service-Oriented Software Engineering – Service Oriented Architecture (SOA), RESTful Services, Service engineering, Service Composition.	08
Module - 2	**No. of Hours.**
Software Dependability and Security: Dependable systems: Dependability Properties, Sociotechnical systems, Redundancy and diversity, Dependable processes, Reliability Engineering – Availability and Reliability, Reliability Requirements, Fault-Tolerant Architectures, Reliability Measurement, Security Engineering – Security and dependability Security Requirements, Secure Systems Design, Security Testing and Assurance.	09
Module - 3	**No. of Hours.**
Software Evolution and Configuration Management: Software Evolution – Evolution Processes, Legacy Systems, Software Maintenance, Quality Management – Software Quality, Quality Assurance, Software Standards, Reviews and Inspections, Software Measurement. Configuration Management – Version Management, System Building, Change Management, Release Management.	09
Module - 4	**No. of Hours.**
Web Application Analysis and Design: Introduction to Web Applications, Characteristics of Web Applications, Web Application Analysis, Content Design, Architectural Design for Web Applications, Navigation Design, Interface Design, User Experience Design, Responsive Web Design Principles, Modeling Web Applications.	08
Module - 5	**No. of Hours.**
Web Application Development, Testing and Maintenance: Web Application Construction, Web Components, Web Services Integration, Testing Web Applications, Functional Testing, Performance Testing, Quality Assurance for Web Applications, Web Application Security, Deployment Strategies, Web Application Maintenance and Evolution.	08

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply software architecture, component-based development, and service-oriented principles in designing large-scale software systems.
CO2	Analyse software reliability, security, quality, and dependability using appropriate engineering techniques and metrics.
CO3	Apply software evolution, configuration management, and process improvement practices to enhance software maintainability.
CO4	Apply web engineering principles to design effective web application architecture, navigation, and user interfaces.
CO5	Apply web engineering practices to develop, test, deploy, and maintain secure and high-quality web applications.

Text Books	
1.	Software Engineering, Ian Sommerville, Pearson Education, 10th Edition, 2016.
2.	Web Engineering A Practitioner's Approach Roger S. Pressman and David Lowe, McGraw-Hill Higher Education, 1st Edition, 2008.

Reference Text Books	
1.	Software Architecture in Practice Len Bass, Paul Clements, and Rick Kazman, Addison-Wesley Professional, 4th Edition, 2021.
2.	Web Engineering GertiKappel, Birgit Pröll, Siegfried Reich, and Werner Retschitzegger, Wiley, 2006.
3.	DevOps A Software Architect's Perspective Len Bass, Ingo Weber, and Liming Zhu, Addison-Wesley Professional, 2015.

Web links and Video Lectures (e-Resources):

- https://ocw.mit.edu/search/?q=software+engineering
- https://developer.mozilla.org/en-US/docs/Learn_web_development
- https://www.w3schools.com/
- https://www.freecodecamp.org/learn/
- https://www.youtube.com/@TraversyMedia

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 50% of 50 marks, i.e., 25 marks. To pass the SEE, a student must score at least 40% of 50 marks, i.e., 20 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 50 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Theory	Internal Assessment-1	50	40 (Average of Best two Assessments)	50
	Internal Assessment-2	50		
	Internal Assessment-3	50		
AAT	Any Two Assessments as per regulations	20	10	
SEE	Semester End Examination	100	50	50
Total Marks				100

SEMESTER END EXAMINATION (SEE):

1. The question paper shall be set for 100 marks and duration of SEE is 3 hours.
2. Two questions of 20 marks (with minimum of 3 sub questions) from each module with internal choice.
3. Students should answer five full questions, selecting one full question from each module.
4. Question papers to be set as per the Blooms Taxonomy levels.

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1

Semester-I					
Advanced Data Structures Laboratory **Category: PCCL**					
Course Code	:	**P26MCSL107**	CIE	:	50Marks
Teaching Hours L:T:P:S	:	0:0:28:02	SEE	:	50Marks
Total Hours / Semester	:	30	Total	:	100Marks
Credits	:	1	SEE Duration	:	3Hrs

Course Learning Objective is	
1.	To implement and analyze priority queues, mergeable heaps, search trees, B-Trees, and hashing techniques for efficient data storage and retrieval.
2.	To apply appropriate data structures for task scheduling, job management, indexing, dynamic storage, and connectivity problems in real-world applications.

PART – A : List of Experiments

1. Task Priority Selection System (Heap)
   - Insert tasks with priorities
   - Identify and execute highest priority task

2. Job Queue Merging System (Leftist Tree)
   - Merge two job queues
   - Maintain priority ordering after merge

3. Adaptive Search System (Splay Tree)
   - Insert and search elements
   - Frequently accessed elements move to root

4. Structured Data Indexing (B-Tree)
   - Insert keys into structured index
   - Maintain sorted hierarchical organization.

5. Dynamic Key Storage System (Extendible Hashing)
   - Insert records into hash buckets
   - Handle overflow using directory expansion

6. Social Group Formation System (DSU)
- Perform union operations
- Check connectivity between members

PART – B: OPEN ENDED EXPERIMENTS

Open-ended experiments are a type of laboratory activity where the outcome is not predetermined and students are given the freedom to explore, design, and conduct the experiment based on the problem statements as per the concepts defined by the course coordinator. It encourages creativity, critical thinking, and inquiry-based learning.

1. Concept 1: Stock Monitoring System (Heap): Track minimum and maximum stock values dynamically
2. Concept 2: Event List Combination System (Leftist Tree) Merge multiple event lists into one ordered list
3. Concept 3: Recently Used Item Tracker (Splay Tree) Track frequently accessed elements using self-adjusting behavior
4. Concept 4: Search Index Verification System (B-Tree) Search for existence of keys in structured index
5. Concept 5: Bucket Distribution System (Extendible Hashing) Observe record distribution across dynamically growing buckets.

6. Concept 6: Network Connectivity Checker (DSU) Determine whether two nodes belong to the same connected group.

Course Outcomes: At the end of the course, the students will be able to	
CO1	Apply basic image processing techniques such as gray scale conversion, filtering, histogram analysis, and Segmentation.
CO2	Implement edge, corner, and feature detection methods to extract important information from images.
CO3	Apply feature matching techniques to compare and analyze images.
CO4	Develop and evaluate basic deep learning models (CNN) for image classification tasks.
CO5	Design and implement computer vision solutions for real-world applications such as object detection, face recognition, and motion analysis

Text Books	
1.	Computer Vision: Algorithms and Applications – Richard Szeliski, 2nd Edition, Springer, 2022.
2.	Computer Vision: Models, Learning, and Inference – Simon J. D. Prince, 1st Edition, Cambridge University Press, 2012.
3.	Deep Learning – Ian Goodfellow, YoshuaBengio, Aaron Courville, MIT Press, 2016.

Reference Text Books	
1.	Dive into Deep Learning – Aston Zhang et al., Latest Online Edition (2023–2025)
2.	Probabilistic Machine Learning: An Introduction – Kevin P. Murphy, MIT Press, 2022.
3.	Learning OpenCV 4 Computer Vision with Python – Joseph Howse, Joe Minichino, Packt, 2020.

Web links and Video Lectures (e-Resources):

- NPTEL – Advanced Data Structures: https://nptel.ac.in/courses/106102064
- MIT Open CourseWare – Advanced Data Structures: https://ocw.mit.edu/courses/6-851-advanced-data-structures-spring-2012/
- VisuAlgo – Data Structure Visualization: https://visualgo.net/en
- GeeksforGeeks – Advanced Data Structures: https://www.geeksforgeeks.org/advanced-data-structures/

ASSESSMENT STRUCTURE:

The assessment in each course is divided equally between Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE), with each carrying 50% weightage. To qualify and become eligible to appear for SEE, in the CIE, a student must score at least 40% of 50 marks, i.e., 20 marks. To pass the SEE, a student must score at least 35% of 50 marks, i.e., 18 marks. Notwithstanding the above, a student is considered to have passed the course, provided the combined total of CIE and SEE is at least 40 out of 100 marks.

CONTINUOUS INTERNAL EVALUATION (CIE):

CIE	Type of Assessment	Max. Marks	Max. Marks Scaling Down to	Total Marks
Laboratory	Lab Conduction & Record	Evaluating Each Expt. for 10 marks.	15	50
	Internal Test – 1	50	15	
	Internal Test – 2	50	20	
SEE	Semester End Examination	100	50	50
Total Marks				**100**

CO-PO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	3	3	2	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	-	-	1
CO3	3	3	3	3	2	-	-	-	-	-	1
CO4	3	3	3	3	2	-	-	-	-	-	1
CO5	3	3	3	3	2	-	-	-	-	-	1