



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M.Sc. Artificial Intelligence & Machine Learning Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC01AIM01	Artificial Intelligence	4-0-0	120	04

• Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate understanding of fundamental concepts of artificial intelligence, including types of AI (narrow and general), Turing test, Chinese room experiment, and application domains.

CLO2: Analyze the development of AI systems through concepts such as the DIKW chain, knowledge-based systems, knowledge acquisition, and knowledge representation techniques.

CLO3: Evaluate ethical considerations in AI by applying principles of Indian philosophy such as Dharma and Karma to address issues like algorithmic bias and responsible AI design.

CLO4: Apply production system concepts for problem-solving, including problem characteristics, search space, and efficiency considerations.

CLO5: Implement and compare search techniques such as breadth-first search, depth-first search, heuristic methods, hill climbing, and A* algorithm for solving AI problems.

CLO6: Analyze and design agent-based systems, including different types of agents, agent communication, and multi-agent system architectures for intelligent applications.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction to Artificial Intelligence Natural and Artificial intelligence, Narrow AI and General AI, Testing intelligence with Turing test, and Chinese room experiment, Nature of AI solutions, Application domains such as Expert, Mundane and Formal tasks, DIKW chain and Evolution of AI based system, Knowledge Based Systems, Knowledge Acquisition and representations, Application areas of artificial intelligence. Ethical AI & Indian Philosophy (Dharma, Karma in Algorithmic Bias).	Interactive Classroom Lecture, ICT-Enabled Learning, Group Discussion, Concept Mapping, Self-Directed Learning	CLO1, CLO2, CLO3
II	Production Systems Problem analysis, Problem characteristics, Production states of problem, Search space, Time and space efficiency, Production system and its characteristics, Applications of production system with examples.	Problem-Based Learning (PBL), Case Study Method, Classroom Lecture, Collaborative Learning	CLO4



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III	Weak Searches Weak and Blind Searches, Breadth first search, Depth first search - Forward & backward chaining - Heuristic search, Generate-and-test, Hill climbing, and Steepest ascent hill climbing, A* algorithm application and uses.	Algorithm Demonstration, Coding Exercises, Research-Oriented Learning, ICT Tools, Practice-Based Learning	CLO5
IV	Agent Based Systems Definition of agent, Characteristics of agent, Typology of Collaborative agent of Interface agent of Mobile agent of Information agent of Intelligent agent of Hybrid agent, Agent communication language, Agents, objects and intelligent systems, Multi agent system architectures and examples.	Project-Based Learning, Seminar/Presentation, Collaborative Learning, Experiential Learning	CLO6

- **(*) Learning Pedagogies/Methods**

Notes:

- (1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
- (2) Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (l) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment (30)

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance



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b. Internal Summative Assessment (20)

(a) Mid -Term

(B) External Assessment (50)

(b) End-Term

(A) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2, CLO3	30	1	1	12	14
II	CLO4	32	1	1	10	12
III	CLO5	28	1	1	10	12
IV	CLO6	30	1	1	12	14
		120	04	04	34	50

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

(B) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	-	-	-	-	-	2	-	-
CLO2	3	3	2	-	-	-	-	2	-	-
CLO3	2	-	-	3	-	-	2	3	-	-
CLO4	3	3	3	-	2	-	-	-	-	-
CLO5	3	3	3	-	3	-	-	-	-	-
CLO6	3	2	3	-	3	2	-	-	-	-



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Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	3rd Edition	Pearson
2	Artificial Intelligence	Elaine Rich, Kevin Knight	2nd Edition	McGraw Hill
3	Introduction to AI	Wolfgang Ertel	2017	Springer
4.	AI: Foundations of Computational Agents	David Poole	2010	Cambridge

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	NPTEL AI Course	https://nptel.ac.in
2	Coursera AI	https://coursera.org
3	MIT AI OpenCourseWare	https://ocw.mit.edu
4	Stanford AI Lectures	https://ai.stanford.edu



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M.Sc. Artificial Intelligence & Machine Learning Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC01AIM02	Mathematical and Statistical Foundations	4-0-0	120	04

• Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate understanding of matrix operations and logic concepts including row/column operations, Gaussian elimination, inverse, logical operators, truth tables, and principles of inference, deduction, and mathematical induction.

CLO2: Apply concepts of graph theory and metrics along with number systems, including Vedic mathematics techniques and traditional numeral systems, in solving computational problems.

CLO3: Solve differential equations of first order and higher order, including homogeneous and non-homogeneous equations, and apply them to real-world problems.

CLO4: Analyze and interpret statistical data using frequency distributions, measures of central tendency, dispersion, least squares method, and hypothesis testing techniques such as chi-square tests.

CLO5: Apply probability concepts including axiomatic probability, conditional probability, Bayes' theorem, and probability distributions (PMF, PDF, CDF) in problem-solving.

CLO6: Analyze bivariate data using statistical tools such as scatter plots, box plots, and correlation techniques including simple, partial, and multiple correlation.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Matrices and Logic Row/Column operations, Gaussian elimination, Decomposition, Inverse, Logic operators AND, OR etc., Truth tables, Theory of inference and deduction, Mathematical inductions, Metrics and basics of graph theory. Vedic Math Sutras (Ekadhikena, Nikhilam, Applications in Algorithms), Number Systems & Zero (Brahmi Numerals, Aryabhata's Place Value System).	Interactive Lecture, Problem Solving, ICT Tools, Self-Directed Learning	CLO1, CLO2
II	Differential Equations Differential equations of first order and first degree, Homogeneous differential equations, Equations - Linear differential equations, Applications of first order, Linear differential equations of higher order, Homogeneous and non-homogeneous linear differential equations with constant coefficients.	Classroom Lecture, Numerical Practice, Problem-Based Learning	CLO3



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III	Basic Statistical Techniques – I Frequency distributions. Measures of central tendency & Measures of dispersion, least square fit, Hypothesis testing and techniques such as chi square testing.	Data Analysis Exercises, Case Study, ICT Tools	CLO4
IV	Basic Statistical Techniques – II Axiomatic definition of probability and properties, conditional probability, multiplication rule. Theorem of total probability, Bayes' theorem and independence of events. Probability mass function, probability density function and cumulative distribution functions, distribution of a function of a random variable. - Bivariate data: Definition, box plot, scatter diagram, simple, partial and multiple correlation.	Problem-Based Learning, Graphical Analysis, Research-Oriented Learning	CLO5, CLO6

- **(*) Learning Pedagogies/Methods**

Notes:

(3) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

(4) Acronyms/abbreviations of the terms can be placed in the above table.

(m) Interactive Classroom Lecture

(n) Classroom Lecture (CL)

(o) Seminars (Student-led and Faculty-moderated)

(p) Micro-Projects/Mini Research Tasks

(q) Industrial Visit/Field Visit/Institutional Visit

(r) Problem-Based Learning (PBL)

(s) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)

(t) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)

(u) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)

(v) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)

(w) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)

(x) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

a. Internal Formative assessment (30)

(a) Quiz

(b) Assignment

(c) Seminar/Presentation

(d) Group Task

(e) Attendance

b. Internal Summative Assessment (20)

(a) Mid -Term



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(C) External Assessment (50)

(a) End-Term

(A) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	1	1	12	14
II	CLO3	32	1	1	10	12
III	CLO4	28	1	1	10	12
IV	CLO5, CLO6	30	1	1	12	14
		120	04	04	34	50

• Assessment and Evaluation

Sr.No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

(B) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	3	2	-	-	-	-	-	-	-
CLO2	3	3	3	-	2	-	-	-	-	-
CLO3	3	2	3	-	-	-	-	-	-	-
CLO4	3	3	3	2	-	-	-	-	-	-
CLO5	3	3	3	-	2	-	-	-	-	-
CLO6	3	3	3	2	-	-	-	-	-	-



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Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Higher Engineering Mathematics	B.S. Grewal	43rd Edition	Khanna
2	Probability & Statistics	Sheldon Ross	2010	Academic Press
3	Discrete Mathematics	Kenneth Rosen	7th Edition	McGraw Hill
4.	Mathematical Statistics	S.C. Gupta	2014	Sultan Chand

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	Khan Academy	https://khanacademy.org
2	NPTEL Mathematics	https://nptel.ac.in
3	MIT OCW Math	https://ocw.mit.edu
4	Statlect	https://statlect.com



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M.Sc. Artificial Intelligence & Machine Learning Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC01AIM03	Python Programming	4-0-0	120	04

• Course Learning Outcomes (CLOs)

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

CLO1: Understand basics of Python (history, features, data types, operators)

CLO2: Apply control structures (branching, looping, string handling)

CLO3: Understand OOP concepts (class, object, inheritance, encapsulation)

CLO4: Use functions, recursion, modules, and variable scope

CLO5: Implement exception handling (built-in and user-defined)

CLO6: Apply algorithms (searching, sorting, hash tables, neural networks)

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Introduction History, Characteristics, Applications, Data types, Operators, Branching process, Control structure, String manipulation and iteration.	Coding Practice, Interactive Lecture, ICT Tools	CLO1, CLO2
II	Class, Objects, and Functions Abstract data types - Inheritance, Encapsulation in python, Functions, and Scoping, Recursions, Global variables, Modules, System functions, and Parameters.	Lab Practice, Mini Projects, Collaborative Learning	CLO3, CLO4
III	Functions & Exception Handling Syntax of function, Inbuilt and User defined Exception, Handling exception.	Debugging Exercises, Practice-Based Learning	CLO5
IV	Application Algorithms Searching and sorting algorithms, Hash tables, Neural networks, Feed forward, K-nearest neighbour – Recurrent.	Algorithm Implementation, Problem Solving	CLO6

• (*) Learning Pedagogies/Methods

Notes:

- The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
- Acronyms/abbreviations of the terms can be placed in the above table.

(a) Interactive Classroom Lecture

(b) Classroom Lecture (CL)

(c) Seminars (Student-led and Faculty-moderated)



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- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (l) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

• Assessment Methodologies

(A) Internal Assessment

a. Internal Formative assessment (30)

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance

b. Internal Summative Assessment (20)

- (a) Mid -Term

(B) External Assessment (50)

- (a) End-Term

(A) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2	30	1	1	12	14
II	CLO3, CLO4	32	1	1	10	12
III	CLO5	28	1	1	10	12
IV	CLO6	30	1	1	12	14
		120	04	04	34	50



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M.Sc. Artificial Intelligence & Machine Learning Semester-I

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

• CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	-	-	-	-	-	-	-	-
CLO2	3	3	3	-	2	-	-	-	-	-
CLO3	3	3	3	-	-	-	-	-	-	-
CLO4	3	3	3	-	2	-	-	-	-	-
CLO5	2	3	3	-	2	-	-	-	-	-
CLO6	3	3	3	-	3	-	-	-	-	-

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CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

• Suggested Learning Materials Books:

Sr.No.	Title	Author(s)	Edition/Year	Publisher
1	Python Crash Course	Eric Matthes	2015	No Starch Press
2	Learning Python	Mark Lutz	5th Edition	O'Reilly
3	Python Programming	Reema Thareja	2017	Oxford

• Online Resources (Open Source)

Sr.No.	Description of Resource(s)	Weblink
1	Python Official Docs	https://python.org
2	W3Schools Python	https://w3schools.com
3	Coursera Python	https://coursera.org
4	NPTEL Python	https://nptel.ac.in



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M.Sc. Artificial Intelligence & Machine Learning Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC01AIM04	Data Structure Algorithms	4-0-0	120	04

• Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate understanding of fundamental concepts of data structures, including Abstract Data Types (ADT), and differentiate between linear and non-linear data structures.

CLO2: Apply linear data structures such as stacks, queues (including circular and deque), and linked lists (singly, doubly, circular) to solve computational problems and evaluate arithmetic expressions.

CLO3: Analyze and implement non-linear data structures including binary trees, binary search trees, AVL trees, heaps, and hash sets for efficient data organization and retrieval.

CLO4: Evaluate graph concepts and apply graph algorithms such as Depth First Search (DFS), Breadth First Search (BFS), Kruskal's algorithm, and Dijkstra's algorithm to solve real-world problems.

CLO5: Analyze the efficiency of algorithms using asymptotic notations and apply divide-and-conquer techniques such as merge sort, quick sort, and binary search.

CLO6: Design and implement algorithmic solutions using advanced paradigms including greedy algorithms, dynamic programming, and backtracking for problems like knapsack and N-Queens.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Linear Data Structures Introduction, Abstract Data Types (ADT), Stack, Queue Circular Queue - Double Ended Queue - Applications of stack, Evaluating Arithmetic Expressions, Other Applications, Applications of Queue, Linked Lists - Singly Linked List, Circularly Linked List, Doubly Linked lists, Applications of linked list.	Coding Practice, Visualization Tools, Problem Solving	CLO1, CLO2
II	Non-Linear Data Structures Binary Tree, expression trees, Binary tree traversals, applications of trees, Huffman Algorithm, Binary search tree, Balanced Trees, AVL Tree, B-Tree, Splay Trees, Heap- Heap operations, Binomial Heaps, Fibonacci Heaps- Hash set.	Simulation, Lab Practice, Case Study	CLO3



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III	Graphs Graphs terminology, Graph ADT, representations, graph search methods DFS and BFS, Applications of Graphs-Minimum cost spanning tree using Kruskal's algorithm, Dijkstra's algorithm for Single Source Shortest Path Problem.	Algorithm Demonstration, Problem-Based Learning	CLO4
IV	Algorithm Analysis Asymptotic Notations, Divide and Conquer, Merge Sort, Quick Sort, Binary Search, Greedy Algorithms, Knapsack Problem, Dynamic Programming, Optimal Binary Search Tree - Back Tracking, N Queen's Problem.	Analytical Exercises, Coding Practice	CLO5, CLO6

- **(*) Learning Pedagogies/Methods**

Notes:

(1) The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.

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- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
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- (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
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- **Assessment Methodologies**

- (A) Internal Assessment**

- a. Internal Formative assessment (30)**

- (a) Quiz
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- b. Internal Summative Assessment (20)**

- (a) Mid -Term



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(B) External Assessment (50)

(b) End-Term

(A) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
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• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
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(B) CLOs – PLOs Matrix

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CLO2	3	3	3	-	2	-	-	-	-	-
CLO3	3	3	3	-	3	-	-	-	-	-
CLO4	3	3	3	-	3	-	-	-	-	-
CLO5	3	3	3	-	3	-	-	-	-	-
CLO6	3	3	3	-	3	-	-	-	-	-



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Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-

- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Data Structures using C	Reema Thareja	2014	Oxford
2	Introduction to Algorithms	Cormen	3rd Edition	MIT Press
3	Data Structures	Seymour Lipschutz	2011	McGraw Hill

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	GeeksforGeeks	https://geeksforgeeks.org
2	NPTEL DSA	https://nptel.ac.in
3	MIT Algorithms	https://ocw.mit.edu
4	Coursera DSA	https://coursera.org



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M.Sc. Artificial Intelligence & Machine Learning Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme	Total Notional Hours	Course credits
			L-P-T		
DSC	P2TNC01AIM05	Relational Database Management System	2-0-0	60	02

• Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate understanding of database fundamentals, including differences between file systems, DBMS, and RDBMS, and core features of relational database systems.

CLO2: Apply relational data modeling concepts such as relations, attributes, tuples, keys (primary, candidate, foreign), and integrity constraints in database design.

CLO3: Analyze and normalize database schemas using functional dependencies and normalization techniques (1NF, 2NF, 3NF, BCNF) to ensure data integrity and efficiency.

CLO4: Construct and execute SQL queries using DDL, DML, and DQL commands, including filtering, grouping, joins, and subqueries for data manipulation and retrieval.

CLO5: Evaluate advanced RDBMS concepts including transactions, ACID properties, concurrency control mechanisms, stored procedures, and triggers for reliable database operations.

CLO6: Analyze modern database trends and architectures, including data warehousing, OLTP vs OLAP systems, ETL processes, and the role of RDBMS in AI/ML and hybrid data environments.

Unit	Course Content	Learning Pedagogies*	CLO(s)
I	Relational Data Modeling & SQL Foundations Introduction to RDBMS, File systems vs DBMS vs RDBMS, Features of RDBMS Relational Model: Relations, tuples, attributes, Keys: Primary, Candidate, Foreign, Integrity constraints. Normalization: Functional dependencies, 1NF, 2NF, 3NF, BCNF, Denormalization (context in analytics systems). Structured Query Language (SQL) – Basics Data Definition Language (DDL): CREATE, ALTER, DROP, Data Manipulation Language (DML): INSERT, UPDATE, DELETE, Data Query Language (DQL): SELECT, Filtering: WHERE, ORDER BY, GROUP BY, HAVING, Joins and Subqueries.	SQL Practice, Hands-on Learning, ICT Tools	CLO1, CLO2, CLO3, CLO4
II	Advanced RDBMS Concepts & AI/ML Integration Transactions & Concurrency Control: Transaction properties (ACID), Serializability, Locking mechanisms and deadlocks Stored Procedures &	Case Study, Project-Based Learning	CLO5, CLO6



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	Triggers: Procedure creation and execution, Trigger-based automation, Use cases in data pipelines Data Warehousing Concepts, OLTP vs OLAP, Star and Snowflake schemas, ETL basics Emerging Trends: NewSQL databases, Comparison with MongoDB (brief overview), Role of RDBMS in hybrid data architectures.		
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- **(*) Learning Pedagogies/Methods**

Notes:

1. The following list is suggestive. Any other learning pedagogies relevant to discipline-specific requirements can be added.
2. Acronyms/abbreviations of the terms can be placed in the above table.

- (a) Interactive Classroom Lecture
- (b) Classroom Lecture (CL)
- (c) Seminars (Student-led and Faculty-moderated)
- (d) Micro-Projects/Mini Research Tasks
- (e) Industrial Visit/Field Visit/Institutional Visit
- (f) Problem-Based Learning (PBL)
- (g) Research-Oriented Learning (Literature Review, Tool Construction, Data Analysis Exercises)
- (h) Collaborative Learning (Group Tasks, Peer Discussion, Joint Presentations)
- (i) Experiential Learning (Community Engagement, Internship-linked Activities, Practice-based Tasks)
- (j) ICT-Enabled Learning (LMS-based Tasks, Digital Resources, Virtual Labs/Webinars)
- (k) Reflective Practices (Learning Journals, Reflective Notes, Concept Mapping)
- (l) Self-Directed Learning (Guided Readings, Concept Exploration Tasks)

- **Assessment Methodologies**

(A) Internal Assessment

b. Internal Formative assessment (15)

- (a) Quiz
- (b) Assignment
- (c) Seminar/Presentation
- (d) Group Task
- (e) Attendance

c. Internal Summative Assessment (10)

- (a) Mid -Term

(B) External Assessment (25)

- (b) End-Term



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(A) Weightage of Learning Efforts for External Assessment

Unit	Aligned COs	Total Learning Hours	Approximate weightage (Marks) to Learning levels (BT)			Total Marks
			Remember (R)	Understanding (U)	Application/ Analyse & above (A)	
I	CLO1, CLO2, CLO3, CLO4	30	1	1	12	14
II	CLO5, CLO6	32	1	1	10	12
		60	02	02	22	26

• Assessment and Evaluation

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50%
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50%

(B) CLOs – PLOs Matrix

CLO	PLO									
	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10
CLO1	3	2	-	-	-	-	-	-	-	-
CLO2	3	3	3	-	-	-	-	-	-	-
CLO3	3	3	3	-	2	-	-	-	-	-
CLO4	3	3	3	-	3	-	-	-	-	-
CLO5	3	2	3	-	3	-	-	-	-	-
CLO6	2	2	3	-	3	2	-	-	-	-

Values to CLO-PLO matrix are assigned by judging the importance of the particular CLO in relation to the PLOs.

CLO – PLO correlation	Value
Strong	3
Moderate	2
Low	1
No correlation	-



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- Suggested Learning Materials Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Database System Concepts	Korth	6th Edition	McGraw Hill
2	Fundamentals of Database Systems	Elmasri	2016	Pearson
3	SQL	C.J. Date	2012	O'Reilly

- Online Resources (Open Source)**

Sr. No.	Description of Resource(s)	Weblink
1	W3Schools SQL	https://w3schools.com
2	Oracle Tutorials	https://oracle.com
3	NPTEL DBMS	https://nptel.ac.in
4	Coursera DBMS	https://coursera.org