GURU NANAK COLLEGE (AUTONOMOUS)

A Sikh Minority Institution | Unit of Guru Nanak Educational Society (Regd.)
Affiliated to University of Madras | Approved by AICTE
Accredited at A++ Grade by NAAC (CGPA 3.68/4)
Guru Nanak Salai, Velachery, Chennai - 600042

SCHOOL OF INFORMATION TECHNOLOGY

M.Sc. Computer Science with Artificial Intelligence

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

Syllabus

(For the PG Batch of 2026 - 28 and thereafter)

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LOCF - LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

PREAMBLE

1. ABOUT THE PROGRAMME

The two-year, methodically planned **M.Sc. Computer Science with Artificial Intelligence** curriculum focuses on artificial intelligence (AI) and aims to provide students with advanced knowledge and practical skills in both core computer science concepts and cutting-edge AI technologies. This multidisciplinary programme prepares graduates for success in the rapidly evolving fields of automation, data science, machine learning, and AI by blending academic knowledge with real-world experience. The extensive curriculum covers a wide range of topics, including computer vision, natural language processing, machine learning, deep learning, big data analytics, data science, and AI ethics. By exploring both the ethical and technological aspects of AI, students will develop the ability to create intelligent systems capable of solving complex problems across various sectors. Students will have access to state-of-the-art labs, tools, and resources, enabling them to engage in both research and hands-on projects. The programme employs a mix of lectures, seminars, group projects, and individual study to foster creativity, critical thinking, and problem-solving skills. While mastering AI technologies, students will also emphasize the importance of communication and collaboration, preparing them to work effectively in multidisciplinary teams. Graduates will be well-equipped to assume leadership roles in AI-related industries or pursue further academic research in computer science and AI. By the end of the programme, students will possess a robust understanding of the fundamental concepts, challenges, and opportunities of AI, empowering them to contribute meaningfully to the development and future advancement of intelligent technologies.

2. VISION

- To develop the technical, analytical, and ethical skills necessary for success in AI, preparing professionals to address current and future challenges in the field.

3. MISSION

- To equip students with the skills and knowledge needed to solve real-world problems using AI.
- To focuses on developing creativity, critical thinking, and ethical decision-making, preparing graduates to lead in the AI field.
- To provide hands-on experience and research opportunities, students will be equipped to tackle both current and future AI challenges.

4. PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

1. Advanced Technical Competence: Postgraduates will acquire in depth knowledge of computer science and allied domains enabling them to excel in industry, academia, and research.
2. Research and Innovation Orientation: Postgraduates will engage in independent and collaborative research, applying analytical reasoning, computational models, and modern tools to develop innovative solutions for scientific, industrial, and societal challenges.

3. Ethics, Professionalism, and Social Responsibility: Postgraduates will uphold ethical standards, integrity, and responsible computing practices, contributing to sustainable technological development and addressing societal needs through IT enabled solutions.
4. Leadership, Communication, and Collaboration: Postgraduates will demonstrate effective communication, teamwork, and leadership skills, preparing them to manage projects, collaborate across disciplines, and contribute to organizational and community development.
5. Adaptability, Lifelong Learning, and Global Readiness: Postgraduates will embrace continuous learning, adaptability, and global perspectives, enabling them to respond to evolving trends in computing, digital transformation, and multidisciplinary applications.

5. PROGRAMME OUTCOMES(POS)

1: Knowledge: Apply knowledge of AI/ML tools and technologies to develop scalable, industry-ready solutions.
2: Problem solving skills: Use problem solving skills in developing AI applications for real-world challenges.
3: Critical Thinking: Incorporate critical thinking in designing innovative AI-based systems.

4: Individual and Teamwork skills: Collaborate using individual and teamwork skills in developing AI solutions.

5: Communication and Lifelong Learning: Communicate and pursue lifelong learning while addressing ethical and social issues in AI.

6. PROGRAMME SPECIFIC OUTCOMES (PSOS)

1. **Uniqueness:** Exhibit proficiency in leveraging advanced AI facilities, industry collaborations, and interdisciplinary exposure to design scalable solutions for real-world challenges.
2. **Research**: Conduct innovative research in AI and ML by applying problem-solving and critical thinking, resulting in contributions that address industrial and societal needs.
3. **Modern Tool Usage:** Effectively use modern AI/ML tools and technologies to design, test, and deploy intelligent systems, while working collaboratively and upholding ethical and social responsibility.

7. PEO – PO MAPPING

	PEO 1	PEO2	PEO3	PEO4	PEO5
PO 1	3	3	2	2	3
PO 2	3	3	3	2	3
PO3	3	3	3	3	3
PO 4	2	3	3	3	3
PO 5	2	2	3	3	3

8. PEO – PSO MAPPING

	PEO 1	PEO2	PEO3	PEO4	PEO5
PSO 1	3	3	2	3	3
PSO 2	3	3	3	2	3
PSO3	3	3	3	3	3

9. CHOICE BASED CREDIT SYSTEM (CBCS)

The College follows the CBCS with Grades under the Semester pattern. Each course is provided with a credit point based on the quantum of subject matter, complexity of the content and the hours of teaching allotted. This is done after a thorough analysis of the content of each course by the members of the Board of Studies and with the approval of the Academic Council. Students are also offered a variety of Job oriented Elective. All PG Students must complete and obtain certification in one NPTEL / SWAYAM-MOOC of their choice before the end of fourth semester. The course will carry 2 credits and is a mandatory requirement for the award of the degree. Students can earn extra credits by opting for Certificate Courses.

The evaluation method under CBCS involves a more acceptable grading system that reflects the personality of the student. This is represented as Cumulative Grade Point Average (CGPA) and Grade Point Average (GPA) which are indicators of the Academic Performance of the student. It provides students with a scope for horizontal mobility and empowers them with the flexibility of learning at their convenience.

Eligibility for Admission

Candidates admitted to the first year of the UG programme should have passed the higher Secondary Examinations (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras. Students applying for the PG programme should have taken the UG degree in the relevant subject from a recognized university as per the norms of the University of Madras.

For B.Com. (Hons): Candidates admitted to the first year of the B.Com. (Hons.) programme should have passed the higher secondary examinations conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereof by the Syndicate of the University of Madras with 75 % cut-off in Commerce/Business studies, Accountancy, Economics and Business Mathematics/ Mathematics.

For MBA: The basic requirement for admission to the MBA programme is a Bachelor's degree in any discipline with a minimum of 50% marks in aggregate and satisfactory test score in MAT Entrance Test conducted by AIMA, New Delhi / TANCET for MBA conducted by Government of Tamil Nadu / CAT / XAT or any other approved MBA Entrance Tests.

For MCA: Only those candidates who have passed B.C.A/B.Sc. in Computer Science or any other equivalent degree OR passed B.Sc./B.Com/BA with Mathematics at 10 + 2 level or at graduation level (with Optional bridge course in Mathematics), provided they have undergone the course under 10+2+3 pattern and obtained at least 50% of marks (45 % marks in case of candidates belonging to reserved category) in the qualifying examination shall be eligible for admission to the M.C.A. Programme.

For M.Sc. Computer Science With Artificial Intelligence: Only those candidates who have passed Bachelor’s Degree in Computer Applications / Information Technology / Data Analytics / Data Science / Software Applications / Computer Science with any specializations or any other equivalent degree at 10 + 2 level or at graduation level, provided they have undergone the course under 10+2+3 pattern and obtained at least 50% of marks (45 % marks in case of candidates belonging to reserved category) in the qualifying examination shall be eligible for admission to the M.Sc. Computer Science With Artificial Intelligence Programme.

Duration of the Course

The UG programme is of three years duration with six semesters and the PG programme is of two years duration with four semesters. The period from June to November is termed as the odd semester and the period from December to April is referred to as the even semester. Each semester must compulsorily have 90 working days before the students appear for the final End Semester Exam.

Course of Study

The main course of study for the Masters' Degree shall consist of the following:

Core Courses

PART - I: Consisting of (a) Core Courses (Including Project) (b) Elective Courses related to the main subject of study.

PART – II:

Ability Enhancement Skills (I, II, III & IV Semesters)

Summer Internship (After II Semester)

10. COURSE STRUCTURE

The M.Sc. Computer Science with Artificial Intelligence programme consists of 8 core theory courses with 4 credits each, 6 core practical courses with 3 credits each, 6 Elective courses with 3 credits each, 4 Ability Enhancement Skills courses with 2 credits each and 1 MOOC/NPTEL course with 4 credit. Internship is a compulsory component with 2 credits and project is a compulsory core course with 13 credits.

Consolidated Credit Structure for all the 2 years

Course component		**No. of Courses**	**Credits**
Part A	Core	15	63
	Elective	6	18
Part B	Ability Enhancement Skills	4	8
	MOOC/NPTEL	1	2
	Internship	1	2
	Total	**26**	**93**

Credit Distribution for Each Semester:

Semester I		Subject	Credit	Hours per week	Marks		Total
Course Component					Internal	External	
Part A	Core - I	Analysis and Design of Algorithms	4	5	50	50	100
	Core - II	Artificial Intelligence and Expert Systems	4	5	50	50	100
	Core - III	Advanced Java Programming	4	5	50	50	100
	Core IV	Practical - I: Analysis and Design of Algorithms Lab	3	4	50	50	100
	Core - V	Practical - II: Advanced Java Programming Lab	3	4	50	50	100
	Elective - I	Mathematics for Computer Science / Discrete Mathematics	3	5	50	50	100
Part B	Ability Enhancement Skills - I	Communication and Presentation Skill	2	2	50	50	100
	Total		**23**	**30**			

Semester II		Subject	Credit	Hrs/ Week	Marks		Total
Course Component					Internal	External	
Part A	Core - VI	Machine Learning with Python	4	5	50	50	100
	Core - VII	Data Science and Analytics	4	5	50	50	100
	Core - VIII	Practical - III: Machine Learning Lab	3	4	50	50	100
	Core - IX	Practical - IV: Data Science and Analytics Lab	3	4	50	50	100

	Elective - II	Advanced Operating Systems/ Social Network Analysis using AI / Blockchain Technology	3	5	50	50	100
	Elective - III	Probability and Statistics / Statistics for Artificial Intelligence	3	5	50	50	100
Part B	Ability Enhancement Skills - II	Quantitative Aptitude	2	2	50	50	100
Total			**22**	**30**			

Semester III **Course Component**		**Subject**	**Credit**	**Hrs/ Week**	**Marks**		**Total**
					Internal	**External**	
Part A	Core – X	Deep Learning	4	4	50	50	100
	Core –XI	Natural Language Processing	4	4	50	50	100
	Core – XII	Full Stack Development	4	4	50	50	100
	Core - XIII	Practical - V: Deep Learning Lab	3	4	50	50	100
	Core - XIV	Practical - VI: Natural Language Processing Lab	3	4	50	50	100
	Elective IV	AI in Healthcare / AI in Economics and Finance / AI in Agriculture	3	4	50	50	100
	Elective V	Network Security and Cryptography /AI in Cloud Computing / Robotic Process Automation	3	4	50	50	100
Part B	Ability Enhancement Skills - III	Open Source AI Tools	2	2	50	50	100
	MOOC/ NPTEL	Self-Study Online Course	2	-	-	-	-

	Internship	Internship	2	-	-	-	-
Total			**30**	**30**			
Semester IV **Course Component**		**Subject**	**Credit**	**Hrs/ Week**	**Marks**		**Total**
					Internal	**External**	
Part A	Elective - VI	Artificial Intelligence Ethics / IT Cognition / Agile Software Engineering	3	4	50	50	100
	Core - XV	Project with Viva Voce	13	24	50	50	100
Part B	Ability Enhancement Skills - IV	Role of AI for Environmental Sustainability	2	2	50	50	100
Total			**18**	**30**			
Total Credits			**93**				
****** Programmes can choose one extra core course (optional) if they give four credit to allied courses***							

11. EXAMINATION

Continuous Internal Assessment (CIA) will be for 50 percent and End Semester Examination (ESE) will be for 50 percent. The CIA marks for the two credit courses (Ability Enhancement skill courses) coming under Part II, shall be awarded based on the nature of the course or at the course instructor's discretion. (Assignment/project/presentation).

Continuous Internal Assessment (CIA)

Every semester will have a mid-semester examination which will be conducted on completion of 45 working days in each semester. A Model exam for three hours duration will be conducted on completion of 85 working days in each semester. Internship credits will be given in semester III after verification of documents by the respective Heads.

The schedule for these tests is as follows:

CIA	Schedule	Syllabus Coverage
Mid Semester Examination	After **45** working days of the Semester	50%
Model Examination	After **85** working days of the Semester	100%

The components for the CIA (Theory & Practical) are as follows:

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment			5
Workbook / recordbook / notebook			5
Class activity 1			5
Class activity 2			5
Class activity 3			5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

The Mode of Evaluation for class activity can be based on the following parameters (these are suggestions, the faculty can add more if needed)

1) Quiz with MCQ
2) Case-Study analysis
3) Debate
4) Seminar/ Presentation
5) Peer/Self-Assessment
6) Role play
7) Scrap book
8) Monograph
9) Puzzle
10) Group Discussion
11) Group activity
12) Surprise class tests

A record of all such assessment procedures will be maintained by the department and is open for clarification. Students will have the right to appeal to the Principal in case of glaring disparities in marking. CIA marks for practical subjects will be awarded by the respective faculty based on the performance of the student in the model practical examination, observation notebook, submission of record books, regularity and attendance for the practical classes. The attendance particulars for practical classes will be maintained by the concerned faculty.

The marks for attendance will be awarded as per the following:

Percenge of General Attendance	**Marks Awarded**
90-100	5
75-89	4
60-74	3
<60	0

End Semester Examinations (ESE)

After the completion of a minimum of 90 working days each semester, the End Semester Examinations will be conducted. Examinations for all UG and PG programmes will be held for all courses in November/December and April/May. Practical examinations will be conducted only during the end of the odd / even semester before, during or after the commencement of the theory exam. The schedule for ESE Practical will be notified by the Controller of Examinations in consultation with the Dean Academics.

Mode of Evaluation

METHODS OF EVALUATION		
Internal Evaluation	Mid Semester Examination (10)	50 Marks
	Model Examination (10)	
	Assignment (10)	
	Class activity (15)	
	Attendance (5)	
External Evaluation	End Semester Examination	50 Marks
Total		**100 Marks**

Method of assessment

Remembering (K1)	● The lowest level of questions requires students to recall information from the course content ● Knowledge questions usually require students to identify information in the textbook. ● Suggested Keywords: **Choose, Define, Find, How, Label, List, Match, Name, Omit, Recall, Relate, Select, Show, Spell, Tell, What, When, Where, Which, Who, Why**
Understanding (K2)	● Understanding off acts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. ● The questions go beyond simple recall and require students to combined at altogether ● Suggested Keywords: **Classify, Compare, Contrast, Demonstrate, Explain, Extend, Illustrate, Infer, Interpret, Outline, Relate, Rephrase, Show, Summarize, Translate**
Application (K3)	● Students have to solve problems by using / applying a concept learned in the classroom. ● Students must use their knowledge to determine a exact response. ● Suggested Keywords: **Apply, Build, Choose, Construct, Develop, Experiment with, Identify, Interview, Make use of, Model, Organize, Plan, Select, Solve, Utilize**
Analyze (K4)	● Analyzing the question is one that asks the students to breakdown something into its component parts. ● Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations. ● Suggested Keywords: **Analyze, Assume, Categorize, Classify, Compare, Conclusion, Contrast, Discover, Dissect, Distinguish, Divide, Examine, Function, Inference, Inspect, List, Motive, Relationships, Simplify, Survey, Take part in, Test for, Theme**
Evaluate (K5)	● Evaluation requires an individual to make judgment on something. ● Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. ● Students are engaged in decision-making and problem–solving. ● Evaluation questions do not have single right answers. ● Suggested Keywords: **Agree, Appraise, Assess, Award, Choose, compare, Conclude, Criteria, Criticize, Decide, Deduct, Defend, Determine, Disprove, Estimate, Evaluate, Explain, Importance, Influence, Interpret, Judge, Justify,**

	Mark, Measure, Opinion, Perceive, Prioritize, Prove, Rate, Recommend, Rule on, Select, Support, Value
Create (K6)	● The questions of this category challenge students to get engaged in creative and original thinking. ● Developing original ideas and problem-solving skills ● Suggested Keywords: **Adapt, Build, Change, Choose, Combine, Compile, Compose, Construct, Create, Delete, Design, Develop, Discuss, Elaborate, Estimate, Formulate, Happen, Imagine, Improve, Invent, Make up, Maximize, Minimize, Modify, Original, Originate, Plan, Predict, Propose, Solution, Solve, Suppose, Test, Theory**

SEMESTER I

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - I**
COURSE NAME: Analysis and Design of Algorithms	**COURSE CODE: 26PCAI301**
SEMESTER: I	**MARKS: 100**
CREDITS:4	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To introduce students to fundamental data structures and algorithm design techniques for efficient problem-solving.

COURSE OUTCOMES:

1. Analyze algorithm efficiency using asymptotic notations.
2. Develop fundamental data structures including arrays, stacks, queues, trees, and heaps.
3. Examine graph traversal and divide-and-conquer techniques for searching and sorting.
4. Design greedy algorithms for optimization problems such as knapsack, MST, and shortest path.
5. Solve optimization and constraint problems using dynamic programming and backtracking.

UNIT I **15 HOURS**

Algorithm Analysis: Algorithm Definition and Characteristics – Time and Space Complexity – Asymptotic Notations (Big-O, Ω, Θ) – Best, Average and Worst Case Analysis. Elementary Data Structures: Arrays – Stacks – Queues – Trees: Binary Tree, Binary Search Tree – Tree Traversals: Inorder, Preorder, Postorder – Heap: Min and Max Heap, Heapify Algorithm- Heap Sort

UNIT II **15 HOURS**

Graph Representation: Adjacency Matrix and Adjacency List. Graph Traversals: Breadth First Search – Depth First Search. Divide and Conquer: General Method – Binary Search – Merge Sort – Quick Sort.

UNIT III **15 HOURS**

The Greedy Method: General Method – Knapsack Problem (Greedy Approach) – Minimum Cost Spanning Tree: Prim's Algorithm and Kruskal's Algorithm – Single Source Shortest Path: Dijkstra's Algorithm.

UNIT IV **15 HOURS**

Dynamic Programming: General Method – All Pair Shortest Path (Floyd-Warshall Algorithm) – Optimal Binary Search Trees (Knuth's Algorithm) – 0/1 Knapsack – Travelling Salesman Problem.

UNIT V **15 HOURS**

Backtracking: General Method – 8-Queens Problem – Graph Coloring – Hamiltonian Cycles. Branch and Bound: General Method – Travelling Salesperson Problem.

RECOMMENDED TEXTBOOKS:

1. E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill.
2. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.

REFERENCE BOOKS:

1. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", by George F. Luger, (2002), Addison-Wesley, Chapter 1- 16, pages 1- 743.
2. "AI: A New Synthesis", by Nils J. Nilsson, (1998), Morgan Kaufmann Inc., Chapter 1- 25, Page 1-493.
3. "Computational Intelligence: A Logical Approach", by David Poole, Alan Mackworth, and Randy Goebel, (1998), Oxford University Press, Chapter 1-12, pages 1-608.
4. Eugene Charniak, Drew Mc Dermot, 'Introduction to Artificial intelligence', Addison Wesley Longman Inc.,2009
5. 4. George. F, William. A. Stubblefield, 'Artificial intelligence and the design of expert systems', The Benjamin Cummins Publishing Co., Inc 2nd Edition, 1992.
6. 5. Robert J Schalkoff, 'Artificial intelligence An Engineering Approach', McGraw Hill International Edition, 1990

E-LEARNING RESOURCES:

1. https://www.ibm.com/downloads/cas/GB8ZMQZ3
2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://nptel.ac.in/courses/106/105/106105077/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	2	2	2	2
CO 2	3	3	2	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	3	2
CO 5	3	3	3	3	3
Ave.	**3.00**	**2.80**	**2.60**	**2.60**	**2.60**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	2
CO 2	3	2	3
CO 3	3	3	2
CO 4	3	3	3
CO 5	3	3	3
Ave.	**3.00**	**2.80**	**2.60**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze algorithm efficiency using asymptotic notations.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop fundamental data structures including arrays, stacks, queues, trees, and heaps.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Examine graph traversal and divide-and-conquer techniques for searching and sorting.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Design greedy algorithms for optimization problems such as knapsack, MST, and shortest path.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Solve optimization and constraint problems using dynamic programming and backtracking.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - II**
COURSE NAME: Artificial Intelligence and Expert Systems	**COURSE CODE: 26PCAI302**
SEMESTER: I	**MARKS: 100**
CREDITS:4	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To understand fundamental AI concepts, to apply problem-solving, search, and knowledge representation techniques, and to analyze expert systems and AI applications for practical problem-solving.

COURSE OUTCOMES:

1. Explain core AI concepts, state-space search, and problem-solving strategies.
2. Develop heuristic search algorithms for computational problems.
3. Represent knowledge using predicate logic, rules, frames, and semantic networks.
4. Design and simulate basic expert systems using CLIPS or PROLOG.
5. Evaluate AI applications, hybrid systems, and reasoning techniques for performance

UNIT I **15 HOURS**

Introduction: AI Problems - Al techniques - Criteria for success. Problems, Problem Spaces, Search: State space search - Production Systems - Problem Characteristics - Issues in design of Search.

UNIT II **15 HOURS**

Heuristic Search techniques: Generate and Test - Hill Climbing- Best-First, Problem Reduction, Constraint Satisfaction, Means-end analysis. Knowledge representation issues: Representations and mappings - Approaches to Knowledge representations -Issues in Knowledge representations - Frame Problem.

UNIT III **15 HOURS**

Using Predicate logic: Representing simple facts in logic - Representing Instance and Isa relationships - Computable functions and predicates - Resolution - Natural deduction. Representing knowledge using rules: Procedural Vs Declarative knowledge- Logic programming - Forward Vs Backward Reasoning - Matching - Control knowledge.

UNIT IV **15 HOURS**

Expert systems: Key components - knowledge base, inference engine, and user interface;
Knowledge representation: Rules, Frames, and Semantic networks; Inference process - Forward chaining and Backward chaining; Expert system development life cycle - Problem definition, Knowledge acquisition, Design, and Testing.

UNIT V **15 HOURS**

Applications: Medical diagnosis, Engineering, Finance, and Customer support; Tools: CLIPS, PROLOG, and Jess, along with hybrid expert systems that incorporate machine learning; Challenges: Knowledge acquisition and uncertainty handling using fuzzy logic and probabilistic reasoning. Advanced topics: Case-based reasoning and Adaptive expert systems, with a look at the integration of modern AI techniques.

RECOMMENDED TEXTBOOKS:

1. E. Rich and K. Knight, Artificial Intelligence, Tata McGraw Hill.
2. S. Russell, P. Norvig, Artificial Intelligence: A Modern Approach, Pearson Education.

REFERENCE BOOKS:

1. "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", by George F. Luger, (2002), Addison-Wesley, Chapter 1- 16, pages 1- 743.
2. "AI: A New Synthesis", by Nils J. Nilsson, (1998), Morgan Kaufmann Inc., Chapter 1- 25, Page 1-493.
3. "Computational Intelligence: A Logical Approach", by David Poole, Alan Mackworth, and Randy Goebel, (1998), Oxford University Press, Chapter 1-12, pages 1-608.
4. Eugene Charniak, Drew Mc Dermot, 'Introduction to Artificial intelligence', Addison Wesley Longman Inc.,2009
5. 4. George. F, William. A. Stubblefield, 'Artificial intelligence and the design of expert systems', The Benjamin Cummins Publishing Co., Inc 2nd Edition, 1992.
6. 5. Robert J Schalkoff, 'Artificial intelligence An Engineering Approach', McGraw Hill International Edition, 1990

E-LEARNING RESOURCES:

1. https://www.ibm.com/downloads/cas/GB8ZMQZ3
2. https://www.javatpoint.com/artificial-intelligence-tutorial
3. https://nptel.ac.in/courses/106/105/106105077/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	2	3	2	3	3
CO 2	3	3	3	3	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**3.0**	**2.8**	**3.0**	**2.8**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	2	3	2
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**3.0**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	**COURSE OUTCOMES**	**POs ADDRESSED**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Explain core AI concepts, state-space search, and problem-solving strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop heuristic search algorithms for computational problems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Represent knowledge using predicate logic, rules, frames, and semantic networks.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Design and simulate basic expert systems using CLIPS or PROLOG.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate AI applications, hybrid systems, and reasoning techniques for performance	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH:2026 - 28**
PART: A	**COURSE COMPONENT: CORE - III**
COURSE NAME: Advanced Java Programming	**COURSE CODE: 26PCAI303**
SEMESTER: I	**MARKS: 100**
CREDITS:4	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To equip students with the concepts and techniques required for developing robust Java-based enterprise applications using modern frameworks, web technologies, and database integration tools. The course enables learners to build, manage, and deploy scalable software solutions for real-world applications.

COURSE OUTCOMES:

1. Develop Java programs using inheritance, interfaces, exception handling, and multithreading.
2. Perform JDBC-based database operations and manage data efficiently.
3. Develop dynamic web applications using Servlets, JSP, and session tracking.
4. Apply Hibernate ORM and Spring MVC to develop enterprise applications.
5. Create RESTful web services using Spring Boot and handle JSON data.

UNIT I **15 HOURS**

Overview of Core Java: Classes, Objects, Methods, Constructors, Parameterized Constructors, Method Overloading. Inheritance: Multilevel Inheritance, Method Overriding.

Packages: Creating Packages, Importing Packages, Access Protection. Interfaces: Definition, Implementation and Usage.

Exception Handling: Types of Exceptions, try, catch, throw, throws, finally, user-defined exceptions. Modern Java Features: Lambda Expressions, Functional Interfaces, Introduction of Stream API.

UNIT II **15 HOURS**

Multithreaded Programming: Java Thread Model, Thread Life Cycle, Creating Threads (Thread class and Runnable interface), Creating Multiple Threads, Thread Priorities, Synchronization, Interthread Communication (wait, notify, notifyAll).

Java Database Connectivity: JDBC Architecture, Types of Drivers, Major JDBC Classes and Interfaces, Establishing Database Connection, Statement, PreparedStatement, CallableStatement, ResultSet Processing, CRUD Operations. Build Tools: Maven – Project Structure, Dependency Management, Project Build Concepts..

UNIT III **15 HOURS**

Servlets: Servlet Architecture, Servlet Life Cycle, Types of Servlets, Handling Client Requests and Server Responses. Form Processing: Reading Form Data, Passing Parameters to Servlets. Advanced Features: Server Side Includes, Servlet Chaining, Filters.

Database Connectivity using Servlets: Session Tracking Techniques: Cookies, HttpSession, Hidden Form Fields, URL Rewriting. Web Concepts: HTTP Methods (GET, POST), Request–Response Model, JSON Handling Overview.

UNIT IV **15 HOURS**

Java Server Pages: Overview, Comparison with Servlets, JSP Architecture, JSP Life Cycle, JSP Processing. Scripting Elements: Scriptlets, Expressions, Declarations.
Directives and Action Tags. Implicit Objects: request, response, session, application, out.

JSP Advanced Features and MVC : Expression Language (EL) and JSP Standard Tag Library (JSTL). JSP Database Access. MVC Architecture - Overview and Role of JSP in View Layer.

UNIT V **15 HOURS**

Hibernate: Overview, Architecture, Object Relational Mapping (ORM), Mapping Types, Hibernate Annotations, Configuration, CRUD Operations, Hibernate Query Language (HQL).

Spring Framework and Spring Boot: Architecture, Dependency Injection, Spring MVC Module (Controller, Model, View). Spring Boot - Overview, Application Development, RESTful Web Services, JSON Data Handling, Configuration and Deployment Concepts.

RECOMMENDED TEXTBOOKS:

1. Herbert Schildt - The Complete Reference Java - Tata McGraw Hill Publishing Company Limited Edition 11, 2018.
2. Uttam K.Roy, Advanced Java programming, Oxford University Press, 2015.

REFERENCE BOOKS:

1. Black Book “Java server programming” J2EE, 1st ed., Dream Tech Publishers, 2008. Kathy walrath”
2. J2EE the Complete Reference, First Edition by Jim Keogh, Tata McGraw Hill, 20l2.
3. Professional Java Server Programming by Subrahmanyam Allamaraju, Cedric Buest Wiley Publication

E-LEARNING RESOURCES:

1. https://www.javatpoint.com/java-tutorial
2. https://docs.oracle.com/javase/tutorial/
3. https://www.roseindia.net/java/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	2	2	2	2	2
CO 2	3	3	3	3	3
CO 3	2	2	2	2	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	2	2	2
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**2.8**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Develop Java programs using inheritance, interfaces, exception handling, and multithreading.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Perform JDBC-based database operations and manage data efficiently.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop dynamic web applications using Servlets, JSP, and session tracking.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply Hibernate ORM and Spring MVC to develop enterprise applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Create RESTful web services using Spring Boot and handle JSON data	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - IV**
COURSE NAME: Practical - I: Analysis and Design of Algorithms Lab	**COURSE CODE: 26PCAI304P**
SEMESTER: I	**MARKS: 100**
CREDITS:3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To enable students to implement and analyze core data structures and algorithms, applying appropriate computational techniques to solve complex problems efficiently.

COURSE OUTCOMES:

1. Develop fundamental data structures such as stack, queue, priority queue, trees, and heaps using C++.
2. Apply searching, sorting, and traversal algorithms including binary search, DFS, BFS, merge sort, and quick sort.
3. Develop programs to solve graph problems including minimum spanning tree and shortest path.
4. Analyze algorithm design techniques such as greedy and dynamic programming for optimization problems.
5. Apply backtracking techniques to solve constraint satisfaction problems such as N-Queens.

Lab Exercises using C++

1. Implement a Stack.
2. Implement a Queue.
3. Apply Binary Search to locate an element in a sorted array.
4. Demonstrate Graph Traversal using Depth First Search (DFS) and Breadth First Search (BFS).
5. Construct a Binary Tree and perform Inorder, Preorder, and Postorder Traversals.
6. Construct Max Heap structures and demonstrate the Heapify operation.
7. Implement Merge Sort to arrange elements in ascending order.
8. Apply Quick Sort to sort a given set of elements.
9. Construct a Minimum Cost Spanning Tree using Kruskal's Algorithm.
10. Construct a Minimum Cost Spanning Tree using Prim's Algorithm.
11. Apply Dijkstra's Algorithm to determine shortest paths from a given vertex in a weighted graph.
12. Apply Floyd–Warshall Algorithm to compute All-Pairs Shortest Paths.
13. Implement the 0/1 Knapsack problem using Dynamic Programming.
14. Implement the Fractional Knapsack problem using the Greedy Method.
15. Implement the N-Queens problem using Backtracking.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	2	3	2	3
Ave.	**3.0**	**2.8**	**2.8**	**2.6**	**2.8**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	2	3
CO 3	3	3	3
CO 4	3	3	2
CO 5	2	3	2
Ave.	**2.8**	**2.8**	**2.6**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Develop fundamental data structures such as stack, queue, priority queue, trees, and heaps using C++.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Apply searching, sorting, and traversal algorithms including binary search, DFS, BFS, merge sort, and quick sort.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop programs to solve graph problems including minimum spanning tree and shortest path.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Analyze algorithm design techniques such as greedy and dynamic programming for optimization problems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Apply backtracking techniques to solve constraint satisfaction problems such as N-Queens.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - V**
COURSE NAME: Practical - II: Advanced Java Programming Lab	**COURSE CODE: 26PCAI305P**
SEMESTER: I	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
PRACTICAL	

COURSE OBJECTIVE

To provide practical exposure in designing, developing and implementing Java-based applications using Core Java, JDBC, Servlets, JSP, Hibernate and Spring frameworks for enterprise application development.

COURSE OUTCOMES

1. Develop Java programs using inheritance, interfaces, exception handling, and multithreading.
2. Perform JDBC-based database operations and manage data efficiently.
3. Develop dynamic web applications using Servlets, JSP, and session tracking.
4. Apply Hibernate ORM and Spring MVC to develop enterprise applications.
5. Create RESTful web services using Spring Boot and handle JSON data.

Lab Exercises using Java

1. Develop a Java program to demonstrate Classes, Objects, Methods, Constructors and Parameterized Constructors.
2. Develop a Java program to implement Multilevel Inheritance, Packages and Interfaces.
3. Write a Java program to implement Exception Handling using try, catch, throw, throws and finally.
4. Develop a Java program to demonstrate Multithreaded Programming, including creating multiple threads, thread priorities, synchronisation, and interthread communication.
5. Write a program using JDBC to create a table, insert records, delete records, and list all records.
6. Develop a JDBC application demonstrating PreparedStatement, CallableStatement and ResultSet operations.
7. Display a welcome message using a Java Servlet.
8. Design a purchase order form using HTML and process it with a Servlet.
9. Write a Java Servlet program to handle and display submitted form data.
10. Write a simple Servlet program to display all received HTTP headers and their values in a table.
11. Develop a program to calculate the percentage of marks of a student using JSP.
12. Prepare an employee payslip using JSP.
13. Write a JSP program that uses the session object to store and retrieve data.
14. Develop a Hibernate application demonstrating Hibernate Architecture, Hibernate Mapping Types, Hibernate Annotation and Hibernate Query Language (HQL).
15. Develop a Spring MVC application to perform database operations.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	2	2	2	3	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**2.8**	**2.8**	**3.0**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	2	2
CO 2	2	3	2
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**2.8**	**2.6**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	**COURSE OUTCOMES**	**POs ADDRESSED**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Develop Java programs using inheritance, interfaces, exception handling, and multithreading.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Perform JDBC-based database operations and manage data efficiently.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop dynamic web applications using Servlets, JSP, and session tracking.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply Hibernate ORM and Spring MVC to develop enterprise applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Create RESTful web services using Spring Boot and handle JSON data.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - I**
COURSE NAME: Mathematics for Computer Science	**COURSE CODE: 26PCAM306**
SEMESTER: I	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To understand the concepts of Set theory, linear algebra, Laplace transform, Fourier integral and Fourier Integrals and Sturm-Liouville.

COURSE OUTCOMES:

1. Apply set theory, relations, and functions to solve computational and engineering problems.
2. Analyze vectors, matrices, linear operators, and eigenvalues for linear algebra applications.
3. Solve linear differential equations using Laplace transforms, convolution, and unit step/Dirac functions.
4. Evaluate signals and systems using Fourier series, integrals, and discrete transforms.
5. Formulate solutions of second-order differential equations using Sturm–Liouville theory and orthogonal expansions.

UNIT I: Set theory: 15 HOURS

Operations on sets – Basic set identities – Relations and orderings –Functions.

UNIT II: Linear algebra: 15 HOURS

Linear vector spaces - Linear operators – vectors in n-dimensions – matrix representation of vectors and operators in a basis – linear independence, dimension – inner product – Schwarz inequality – Orthonormal basis – Gram-Schmidth process – Eigenvalues and eigenfunctions of operators/matrices — Cayley Hamilton theorem – Eigen basis, Diagonalizing matrix – Quadratic forms – Complex matrices and forms- Hermitian and Unitary operators/matrices.

UNIT III: Laplace transforms: 15 HOURS

Laplace Transforms – Convolution theorem – Solution of linear differential equations with constant coefficients – Unit step function and Dirac delta function.

UNIT IV: Fourier Integrals and Transforms: 15 HOURS

Fourier series - Fourier integral – Fourier sine and cosine transforms – Fourier transform- convolution theorem - Discrete Fourier transform and Fast Fourier transform.

UNIT V: Sturm-Liouville theory: **15 HOURS**

Second order linear differential equations – Strum-Liouville theory – Orthogonality of eigenfunctions – Illustration with Legendre, Laguerre, Hermite, Chebyshev differential equations - expansion of polynomials.

RECOMMENDED TEXTBOOKS:

1. B Kolman, R C Busby, and S* C Ross, *Discrete Mathematical Structures*, 6th Edition (Pearson Prentice-Hall, New Delhi, 2009).
2. E Kreyszig, *Advanced Engineering Mathematics*, 10th Edition (Wiley, NY, 2011).
3. M D Greenberg, *Advanced Engineering Mathematics***,** 2nd Edition, International Edition (Prentice-Hall International, NJ, 1998; Pearson Education Asia, New Delhi, 2002).
4. J P Tremblay and R Manohar, *Discrete Mathematical Structures with Applications to Computer Science***,** International Edition (McGraw-Hill, Singapore, 1987; Tata McGraw-Hill, New Delhi, 1997).

REFERENCE BOOKS:

1. E R Scheinerman, *Mathematics*: *A Discrete Introduction* (Brooks/Cole/Thomson Asia, Singapore, 2001).
2. S Lipschutz, M L Lipson, and V* H Patil, *Discrete Mathematics*, 2nd Edition (Tata McGraw-Hill, New Delhi, 2006).
3. L A Pipes and L R Harvill, *Applied Mathematics for Engineers and Physicists***,** 3rd Edition. (McGraw-Hill, NY, 1971).

E-LEARNING RESOURCES

1. https://onlinecourses.nptel.ac.in/noc24_ma42/preview
2. **https://archive.nptel.ac.in/courses/111/106/111106051/**
3. **https://archive.nptel.ac.in/courses/111/106/111106100/#**
4. **https://archive.nptel.ac.in/courses/111/106/111106139/**
5. **https://archive.nptel.ac.in/courses/111/106/111106046/**

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	**QUESTION COMPONENT**	**NUMBERS**	**MARKS**	**TOTAL**
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B - 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	3	2	3	3	2
CO 3	3	3	2	2	3
CO 4	2	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**2.8**	**2.8**	**2.8**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	2	2	3
CO 2	3	3	2
CO 3	3	2	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**2.6**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply set theory, relations, and functions to solve computational and engineering problems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Analyze vectors, matrices, linear operators, and eigenvalues for linear algebra applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Solve linear differential equations using Laplace transforms, convolution, and unit step/Dirac functions.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Evaluate signals and systems using Fourier series, integrals, and discrete transforms.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Formulate solutions of second-order differential equations using Sturm–Liouville theory and orthogonal expansions.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Problem solving sessions	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - I**
COURSE NAME: Discrete Mathematics	**COURSE CODE: 26PCAM306**
SEMESTER: I	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To understand the concepts of logics, predicate logic, sets, basic graphs and planar graphs.

COURSE OUTCOMES:

1. Apply statements and logical connectives to evaluate formulas and logical equivalence.
2. Analyze predicates and quantifiers to derive formal proofs using inference rules.
3. Examine set theory and relations to compute closures and apply inclusion–exclusion.
4. Design directed graphs to analyze matrices and develop transitive closure.
5. Evaluate planar graphs using Kuratowski's theorem and Euler's formula.

UNIT I **15 HOURS**

MATHEMATICAL LOGIC

Lectures Statements, Connectives, Statement formulas, Truth functional rules, Interpretation of formulas, Tautologies, Equivalence, Functionally complete set of connectives, Normal forms, Inference, Theory of statement calculus, Consistency of premises.

UNIT II **15 HOURS**

PREDICATE LOGIC

Lectures Predicates, statement functions, Quantification, Interpretation of predicate formulas, Inference theory for predicate calculus, Informal & formal proofs.

UNIT III **15 HOURS**

SET THEORY

Basics of set theory, Properties of relations, equivalence & compatibility relation, Representation of relations, Reflective, symmetric & transitive closures, Characteristic functions of a set and its properties, Principle of inclusion and exclusion, its applications.

UNIT IV **15 HOURS**

GRAPH THEORY

Lectures Definition Simple digraphs, Matrix representations, Paths, Distances, Connectedness of digraphs, Path and reachability matrices, Boolean sum and product of bit matrices, Warshall's algorithm for transitive closure of relations.

UNIT V **15 HOURS**

PLANAR GRAPHS

Planarity of graphs, Planar graphs Stereographic projection and embedding on a sphere Kurtowski's two graphs, Euler's formula, Hamiltonian graphs, Detection of planarity and elementary reduction.

RECOMMENDED TEXTBOOKS:

1. T.Veerarajan, "Discrete Mathematics" Tata McGraw Hill Pub. Co. Ltd., New Delhi,
2. Frank Harary, "Graph theory" Addison Wesley publishing company.

REFERENCE BOOKS:

1. Rosen Kenneth: Discrete mathematics and its applications. McGraw hill- New Delhi.
2. Stanat and McAlister: Discrete Mathematics for Computer Science, PHI
3. Narsingh Deo: Graph Theory with Applications to Engineering and Computer Science, PHI, 1974
4. J.P. Tremblay and Manohar: Discrete mathematical structures with application to Computer Science, McGraw hill- New Delhi.

E-LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc22_cs123/preview
2. https://archive.nptel.ac.in/courses/106/108/106108227/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	3	3	2	3	2
CO 3	3	3	3	2	3
CO 4	3	2	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**2.8**	**2.8**	**2.8**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	2	2	3
CO 2	3	3	2
CO 3	3	2	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**2.6**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply statements and logical connectives to evaluate formulas and logical equivalence.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Analyze predicates and quantifiers to derive formal proofs using inference rules.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Examine set theory and relations to compute closures and apply inclusion–exclusion.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Design directed graphs to analyze matrices and develop transitive closure.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate planar graphs using Kuratowski's theorem and Euler's formula.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Problem solving sessions	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: B	**COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS - I**
COURSE NAME: Communication and Presentation Skills	**COURSE CODE: 26PGSL401**
SEMESTER: I	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVE:

To build communication skills for personal and professional development.

COURSE OUTCOMES:

1. Demonstrate the ability to listen to others actively, understand diverse perspectives, and paraphrase key points accurately, enhancing their comprehension skills in various personal and professional contexts.
2. Articulate thoughts, ideas, and information clearly and concisely, using appropriate language and structure to convey messages effectively in both written and verbal communication.
3. Develop confidence in expressing opinions, asserting boundaries, and advocating for themselves and others, enhancing self-assurance and effectiveness in interpersonal and group communication.
4. Demonstrate their communication style and approach based on the audience, context, and purpose of communication, fostering flexibility and versatility in interacting with diverse individuals and groups
5. Apply techniques for resolving conflicts, managing disagreements, and negotiating mutually beneficial outcomes through effective communication strategies, promoting constructive problem-solving and collaboration in personal and professional settings.

UNIT I **6 HOURS**

Essentials of Effective Communication: Communication Skills-LSRW- Characteristic features of LSRW-Consequences of Ineffective Communication-Impact of Technology on Communication

UNIT II **6 HOURS**

Types of Communication: Verbal Communication – Non-verbal Communication- Visual Communication - Written Communication-Group Communication-Digital Communication- Formal and Informal Communication-Vertical-Horizontal-Diagonal Grapevine

UNIT III **6 HOURS**

Barriers in Communication: Physical Barriers - Language Barriers - Social and Cultural Barriers - Psychological Barriers - Semantic Barriers - Interpersonal Barriers - Technological Barriers- Means to overcome the various barriers to Communication

UNIT IV **6 HOURS**

Etiquettes and Ethical Practices in Communication: Active Listening - Clarity and Conciseness - Professional Tone - Timeliness - Constructive Feedback-Transparency- Professionalism-Accountability-Confidentiality-Cultural Sensitivity- Emotional Intelligence- Empathy-Social Intelligence-Social Etiquettes- Appreciation and Gratitude.

UNIT V **6 HOURS**

Presentation Skills : Types of Presentation- Preparing a presentation-Do's and Don'ts while giving a presentation-Managing tools for presentation-Using Prompts-Making effective uses of Audio/Visual aids during presentation-Dealing with Questions, Interruptions and Pauses- Practical: Participating in Mock presentations

RECOMMENDED TEXTBOOKS:

1. Monippally, Matthukutty, M. Business Communication Strategies. New Delhi: Tata McGraw-Hill Publishing Company Ltd., 2001.
2. Peter, Francis. (2012) Soft Skills and Professional Communication. New Delhi: Tata McGraw Hill.
3. Raman, Meenakshi & Prakash Singh (2012) Business Communication Oxford University Press

REFERENCE BOOKS

1. Gallo, Maria. D (2018) Stop Lecturing Start Communicating: The Public Speaking Survival Guide for Business Kindle Edition
2. Hasson, Gill. (2012) Brilliant Communication Skills. Great Britain: Pearson Education.
3. Patil, Shailesh (2020) Handbook on Public Speaking, Presentation & Communication Skills: Principles & Practices to create high impact presentations & meaningful conversations, Chennai, Notion Press Media Pvt Ltd.

E-LEARNING RESOURCES

1. https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/effective- communication-barriers-and-strategies
2. https://www.coursera.org/articles/presentation-skills
3. https://positivepsychology.com/how-to-improve-communication-skills/

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7 questions (answer in 50 words)	1-7	2	**10**
B	Answer any 4 out of 6 questions (answer in 300 words)	8-13	5	**20**
C	Answer any two(Internal (Choice)	14-15	10	**20**
	Internal & Viva Voce		50	50

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	----
II	2	1	1
III	1	1	1
IV	1	1	1
V	1	1	1
TOTAL	**SECTION A - 7**	**SECTION B - 6**	**SECTION C - 4**

SEMESTER II

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - VI**
COURSE NAME: Machine Learning with Python	**COURSE CODE: 26PCAI307**
SEMESTER: II	**MARKS: 100**
CREDITS:4	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To understand the different types, steps and algorithms involved in Machine Learning Process..

COURSE OUTCOMES:

1. Apply data analysis techniques using NumPy and pandas for statistical analysis and visualization.
2. Develop and evaluate classification algorithms using scikit-learn.
3. Analyze machine learning models using preprocessing, feature selection, and dimensionality reduction.
4. Design machine learning methods including regression, clustering, and ensemble techniques.
5. Develop and deploy machine learning models using Flask and database integration.

UNIT I **15 HOURS**

Data Analytics with pandas and NumPy - NumPy and basic stats - Matrices - pandas library - Working with data - Null Values - Creating statistical graphs Giving Computers the ability to learn from data - Introduction - Building intelligent systems to transform data into knowledge - The three different types of Machine Learning (ML) - Introduction to basic terminology and notations - A roadmap for building ML systems - Using Python for ML Training Simple ML Algorithms for Classification - Early History of ML - Implementing a Perceptron learning algorithm - Adaptive linear neurons and the convergence of learning.

UNIT II **15 HOURS**

ML Classifiers using sckikit-learn - Choosing a classification algorithm - Training a perceptron - Modeling class probabilities via logistic regression - Maximum margin classification with support vector machines (SVM) - Solving nonlinear problems using a kernel SVM - Decision tree learning - K- nearest neighbours: a lazy learning algorithm.

Data Preprocessing - Missing data - Categorical data - Partitioning a dataset into separate training and test datasets - Bringing features onto the same scale - Selecting meaningful features - Assessing feature importance with random forests

UNIT III **15 HOURS**

Compressing Data via Dimensionality Reduction - Unsupervised dimensionality reduction via principal component analysis - Supervised data compression via linear discriminant analysis - Using kernel principal component analysis for nonlinear mappings.

Learning Best Practices for Model Evaluation and Hyperparameter Tuning -- Streamlining workflows with pipelines - Using k-fold cross-validation to assess model performance - Debugging algorithms with learning and validation curves - Fine-tuning ML models via grid search - Looking at different performance evaluation metrics.

UNIT IV **15 HOURS**

Combining different models for ensemble learning - Learning with ensembles - Combining classifiers via majority vote - Bagging: building an ensemble of classifiers from bootstrap samples - Leveraging weak learners via adaptive boosting.

Predicting Continuous Target Variables with Regression Analysis - Introducing Linear regression - Implementing an ordinary least squares linear regression model - Fitting a robust regression model using RANSAC - Evaluating the performance of linear regression models - Using regularised methods for regression - Turning a linear regression model into a curve - polynomial regression - Dealing with nonlinear relationships using random forests.

UNIT V **15 HOURS**

Working with Unlabeled Data – Grouping objects by similarity using k-means - Organising clusters as a hierarchical tree - Locating regions of high density via DBSCAN .

Introduction to Embedding a ML model into a Web Application - Serialising fitted scikit-learn estimators - Setting up an SQLite database for data storage - Developing a web application with Flask - Turning any classifier into a web application - Deploying the web application to a public server.

RECOMMENDED TEXTBOOKS:

1. Corey Wade et al, Vahid Mirjalili, The Python Workshop, 2nd Edition, packs publishing, 2022
2. Sebastian Raschka and Vahid Mirjalili, Python Machine Learning, 3rd Edition, packt publishing, 2019

REFERENCE BOOKS:

1. Andreas C. Mueller, Sarah Guido. Introduction to Machine Learning with Python. O'Reilly Media, Inc., 2016.
2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012, 2010
3. Wes McKinney. Python for Data Analysis. O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, second edition, 2018

E-LEARNING RESOURCES:

1. https://data-flair.training/blogs/machine-learning-tutorial/
2. https://www.geeksforgeeks.org/machine-learning/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	3	2
CO 2	3	3	3	2	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	2
CO 5	2	3	3	3	3
Ave.	**2.8**	**3.0**	**2.8**	**2.8**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	2
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	2	2	3
Ave.	**2.8**	**2.8**	**2.**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	**COURSE OUTCOMES**	**POs ADDRESSED**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Apply data analysis techniques using NumPy and pandas for statistical analysis and visualization.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop and evaluate classification algorithms using scikit-learn.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Analyze machine learning models using preprocessing, feature selection, and dimensionality reduction.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Design machine learning methods including regression, clustering, and ensemble techniques.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop and deploy machine learning models using Flask and database integration.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - VII**
COURSE NAME: Data Science and Analytics	**COURSE CODE: 26PCAI308**
SEMESTER: II	**MARKS: 100**
CREDITS:4	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To equip students with the knowledge and practical skills to acquire, clean, analyze, and visualize data using R, enabling data-driven decision making and effective interpretation of real-world datasets.

COURSE OUTCOMES:

1. Analyze the data science ecosystem, data types, sources, ethics, and governance.
2. Apply R to acquire, clean, and manipulate data using appropriate structures and packages.
3. Perform data cleaning, transformation, and quality assessment for reliable datasets.
4. Perform exploratory data analysis and visualize patterns and insights.
5. Develop data analytics solutions for decision-making using KPIs, dashboards, and reporting tools.

UNIT I **15 HOURS**

Data Science Foundations and Data Ecosystem: Evolution of Data Science and Analytics – Data types and data structures in real-world systems – Data generation sources: sensors, transactions, social media, logs – Data science lifecycle and analytics workflow – Introduction to data warehousing and data lakes – Data governance, data privacy and ethical considerations – Open data platforms and data repositories.

UNIT II **15 HOURS**

Data Acquisition and Management using R: R environment and workflow using RStudio – Data structures: vectors, matrices, lists, data frames – Data acquisition techniques: reading CSV, Excel, JSON and web data – Data integration from multiple sources – Data storage concepts: flat files and databases overview – Data manipulation using dplyr: filter, select, mutate, summarise – Data tidying using tidyr.

UNIT III **15 HOURS**

Data Cleaning, Transformation and Quality Assessment: Nature of dirty data and real-world data issues – Handling missing, duplicate and inconsistent data – Outlier detection techniques: statistical and visual methods – Data transformation: scaling, normalization, encoding and type conversion – Data reduction techniques: aggregation, sampling and feature selection (concept only) – Data quality dimensions: accuracy, completeness and consistency.

UNIT IV **15 HOURS**

Exploratory Data Analysis and Statistical Insights: Descriptive statistics and data summarization – Distribution analysis and pattern identification – Correlation and covariance analysis – Hypothesis testing: t-test and chi-square (concept and application) – Data visualization principles – Visualization using ggplot2: univariate, bivariate and multivariate analysis – Data interpretation and insight extraction.

UNIT V **15 HOURS**

Data Analytics Applications and Decision Support: Types of analytics: descriptive and diagnostic analytics in detail, predictive and prescriptive analytics overview – KPI design and performance metrics – Data-driven decision making frameworks – Dashboard design principles – Tools for reporting: Excel and Power BI basics – Case studies: business performance analysis, customer behavior analysis (non-ML approach), financial and operational analytics – Communicating insights through reports and visual storytelling.

RECOMMENDED TEXTBOOKS:

1. Hadley Wickham & Garrett Grolemund, R for Data Science, O'Reilly Media, 2017.
2. K.P. Soman, Shyam Diwakar & V. Ajay, Insight into Data Mining, PHI Learning, 2006.

REFERENCE BOOKS:

1. Gareth James, Daniela Witten, Trevor Hastie & Robert Tibshirani, An Introduction to Statistical Learning, Springer, 2013.
2. Wayne Winston, Business Analytics: Data Analysis & Decision Making, Cengage, 2014.
3. Hadley Wickham, Advanced R, Chapman & Hall/CRC, 2014.
4. A Simple Introduction to Data Science - Lars Nielson, 2015.
5. Introducing Data Science - Davy Cielen, Arno D.B. Meysman, Mohamed Ali, 2016, Manning Publication.
6. Data Science & Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data

E-LEARNING RESOURCES:

1. *R for Data Science (Free Online Book)* – https://r4ds.had.co.nz/
2. *An Introduction to Statistical Learning (Free PDF with R Labs)* – https://www.statlearning.com/
3. *tidyverse Tutorials and Documentation* – https://www.tidyverse.org/learn/

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	2	3	2	3
CO 2	3	3	2	3	2
CO 3	3	3	3	2	2
CO 4	3	3	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**2.8**	**2.8**	**2.6**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	2
CO 2	3	2	3
CO 3	3	3	3
CO 4	3	3	2
CO 5	3	3	3
Ave.	**3.0**	**2.8**	**2.6**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze the data science ecosystem, data types, sources, ethics, and governance.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Apply R to acquire, clean, and manipulate data using appropriate structures and packages.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Perform data cleaning, transformation, and quality assessment for reliable datasets.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Perform exploratory data analysis and visualize patterns and insights.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop data analytics solutions for decision-making using KPIs, dashboards, and reporting tools.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: Core - VIII**
COURSE NAME: Practical - III: Machine Learning Lab	**COURSE CODE: 26PCAI309P**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To provide practical knowledge of machine learning techniques, data preprocessing, model development, evaluation, and deployment using Python-based tools for solving real-world problems.

COURSE OUTCOMES:

1. Apply data analysis and visualization techniques using NumPy and pandas.
2. Develop and analyze classification algorithms using scikit-learn.
3. Evaluate and optimize machine learning models using dimensionality reduction and tuning.
4. Design and apply regression and ensemble learning techniques for prediction.
5.: Develop and deploy machine learning models using clustering and Flask integration.

Lab Exercises using Python

1. Implement data preprocessing using NumPy and pandas for statistical analysis and handling missing values.
2. Develop visualization techniques using graphs to analyze and interpret dataset patterns.
3. Create Perceptron and Adaline models for binary classification tasks.
4. Implement perceptron training using scikit-learn and evaluate convergence behaviour.
5. Implement data preprocessing techniques such as feature scaling, categorical encoding, and train-test split using scikit-learn.
6. Create classification systems using SVM, kernel SVM, and decision tree algorithms.
7. Implement PCA and LDA techniques for dimensionality reduction on datasets.
8. Develop model evaluation pipelines using k-fold cross-validation and performance metrics.
9. Create hyperparameter tuning systems using grid search and learning curve analysis.
10. Create ensemble learning models using bagging and boosting techniques.
11. Develop linear regression models using ordinary least squares and evaluate performance.
12. Implement random forest models and extract feature importance for analysis of datasets.
13. Create clustering models using k-means, hierarchical clustering, and DBSCAN algorithms.
14. Implement model serialization using pickle/joblib and deploy machine learning models using Flask and SQLite integration.
15. Implement a machine learning web application using Flask with a deployment workflow.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	3	2
CO 2	3	3	3	2	2
CO 3	3	3	3	2	3
CO 4	3	3	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**3.0**	**2.8**	**2.6**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	2	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	2
CO 5	2	3	3
Ave.	**2.8**	**2.8**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	**COURSE OUTCOMES**	**POs ADDRESSED**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Apply data analysis and visualization techniques using NumPy and pandas.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop and analyze classification algorithms using scikit-learn.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Evaluate and optimize machine learning models using dimensionality reduction and tuning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Design and apply regression and ensemble learning techniques for prediction.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop and deploy machine learning models using clustering and Flask integration.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: Core - IX**
COURSE NAME: Practical - IV: Data Science and Analytics Lab	**COURSE CODE: 26PCAI310P**
SEMESTER: II	**MARKS: 100**
CREDITS:3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To provide practical knowledge of machine learning techniques, data preprocessing, model development, evaluation, and deployment using Python-based tools for solving real-world problems.

COURSE OUTCOMES:

1. Apply R programming techniques to analyze datasets using arithmetic, logical operations, and transformations.
2. Develop R scripts using vectors, matrices, lists, data frames, and control structures.
3. Create R functions and workflows to clean, integrate, and preprocess data.
4. Create visualizations and perform exploratory analysis using base R and ggplot2.
5. Evaluate data quality and ensure ethical, consistent, and reproducible analysis.

Lab Exercises using R Programming

1. Develop an R program to illustrate basic data types and perform arithmetic and logical operations to examine data characteristics.
2. Construct R scripts to create and manipulate vectors, matrices, lists, and data frames, and perform indexing and subsetting operations.
3. Apply control structures in R to implement conditional statements, loops, and user-defined functions for data processing tasks.
4. Develop an R program to import and export datasets in CSV, Excel, and text formats and verify data integrity.
5. Examine a dataset using R functions to summarize structure, dimensions, and basic statistics.
6. Analyze a dataset to identify and handle missing values using appropriate data cleaning techniques.
7. Construct R programs to detect duplicate records and resolve inconsistencies in datasets.
8. Apply data transformation techniques to perform type conversion, normalization, filtering, and subsetting of data.
9. Utilize dplyr functions to filter, select, transform, and aggregate data for analytical purposes.
10. Apply tidyr functions to reshape and tidy datasets by performing pivoting and restructuring operations.
11. Develop an R program to compute descriptive statistics such as mean, median, variance, and standard deviation and interpret the results.

12. Construct visualizations to represent data distributions using bar charts, histograms, pie charts, and box plots.
13. Create advanced visualizations using ggplot2 to analyze relationships among variables through scatter plots and multi-variable graphs.
14. Perform exploratory data analysis to identify patterns, correlations, and outliers, and interpret findings.
15. Carry out a case study to analyze a real-world dataset, perform preprocessing, visualization, and generate a structured analytical report.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	2	3	2
CO 2	3	3	3	2	2
CO 3	3	3	3	3	3
CO 4	3	2	3	2	3
CO 5	2	2	3	3	3
Ave.	**2.8**	**2.6**	**2.8**	**2.6**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	2	3
CO 3	3	3	3
CO 4	3	3	2
CO 5	2	3	2
Ave.	**2.8**	**2.8**	**2.6**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply R programming techniques to analyze datasets using arithmetic, logical operations, and transformations.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop R scripts using vectors, matrices, lists, data frames, and control structures.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Create R functions and workflows to clean, integrate, and preprocess data.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Create visualizations and perform exploratory analysis using base R and ggplot2.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate data quality and ensure ethical, consistent, and reproducible analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - II**
COURSE NAME: Advanced Operating Systems	**COURSE CODE: 26PCAI311**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVES

To provide students with in-depth knowledge of advanced operating system concepts, including process management, distributed systems, real-time and mobile OS, and practical insights through Linux-based case studies.

COURSE OUTCOMES

1. Analyze operating system architectures using performance parameters such as throughput, latency, and scalability.
2. Design process scheduling and deadlock handling algorithms for system-level problems.
3. Develop real-time task scheduling models and evaluate performance using scheduling metrics.
4. Examine handheld operating systems by analyzing security features and architecture.
5. Evaluate security, privacy, and resource management issues and propose mitigation strategies.

UNIT I **15 HOURS**

Basics of Operating Systems: What is an Operating System? – Main frame Systems – Desktop Systems – Multiprocessor Systems – Distributed Systems – Clustered Systems –Real-Time Systems – Handheld Systems – Feature Migration – Computing Environments -Process Scheduling – Cooperating Processes – Inter Process Communication- Deadlocks –Prevention – Avoidance – Detection – Recovery.

UNIT II **15 HOURS**

Distributed Operating Systems: Issues – Communication Primitives – Lamport‟s Logical Clocks – Deadlock handling strategies – Issues in deadlock detection and resolution-distributed file systems –design issues – Case studies – The Sun Network File System-Coda.

UNIT III **15 HOURS**

Realtime Operating Systems : Introduction – Applications of Real Time Systems – Basic Model of Real Time System – Characteristics – Safety and Reliability - Real Time Task Scheduling.

UNIT IV **15 HOURS**

Operating Systems Handheld Systems: Requirements – Technology Overview – Handheld Operating Systems – Palm OS – Symbian Operating System – Android – Architecture of Android – Securing Handheld Systems.

UNIT V **15 HOURS**

Case Studies : Linux System: Introduction – Memory Management – Process Scheduling – Scheduling Policy - Managing I/O devices – Accessing Files- iOS : Architecture and SDK Framework - Media Layer - Services Layer - Core OS Layer - File System.

RECOMMENDED TEXTBOOKS:

1. Abraham Silberschatz; PeterBaer Galvin; GregGagne,"Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
2. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems –Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.

REFERENCE BOOKS

1. Rajib Mall,"Real-Time Systems:Theory and Practice",Pearson EducationIndia,2006.
2. Pramod Chandra P.Bhatt, An introduction to operating systems, concept and practice, PHI, Third edition, 2010.
3. Daniel .P.Bovet & Marco Cesati,"UnderstandingtheLinuxkernel",3rd edition, O"Reilly,2005
4. Neil Smyth, "iPhoneiOS4DevelopmentEssentials–Xcode", Fourth Edition, Payload media, 2011.

E-LEARNING RESOURCES

1. https://onlinecourses.nptel.ac.in/noc20_cs04/preview
2. https://www.dacity.com/course/advanced-operating-systems--ud189
3. https://minnie.tuhs.org/CompArch/Resources/os-notes.pdf

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	2	3	2	3	2
CO 2	3	3	3	3	2
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**2.8**	**3.0**	**2.8**	**3.0**	**2.6**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	2	2	2
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**2.8**	**2.8**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No:	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze operating system architectures using performance parameters such as throughput, latency, and scalability.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design process scheduling and deadlock handling algorithms for system-level problems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop real-time task scheduling models and evaluate performance using scheduling metrics.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Examine handheld operating systems by analyzing security features and architecture.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate security, privacy, and resource management issues and propose mitigation strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - II**
COURSE NAME: Social Network Analysis using AI	**COURSE CODE: 26PCAI323**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVES

To enable students to understand and apply AI techniques to analyze social networks and their data, while also learning about important ethical issues.

COURSE OUTCOMES

1. Apply AI/ML techniques (classification, clustering, GNNs) to analyze social network datasets and achieve performance metrics.
2. Design AI-based solutions for social network problems and validate using real or benchmark datasets.
3. Develop graph-based models for community detection and influence propagation.
4. Apply AI tools and frameworks to build prototypes for social network analysis.
5. Evaluate ethical, privacy, and bias issues and propose responsible AI strategies.

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UNIT I: Introduction to Social Network Analysis and AI **15 HOURS**

Introduction to social networks: Nodes, edges, graphs - Basic concepts of social network analysis (SNA) - Role of AI in social network analysis.

UNIT II: Graph Theory and Machine Learning Basics **15 HOURS**

Graph theory fundamentals: Vertices, edges, adjacency matrices - Basic machine learning algorithms used in SNA (e.g., classification, clustering).

UNIT III: Advanced Techniques in Social Network Analysis **15 HOURS**

Introduction to Graph Neural Networks (GNNs) - Applications of GNNs in social network analysis - Community detection, influence propagation, and recommendations.

UNIT IV: Practical Applications of AI in Social Networks **15 HOURS**

Fake news detection, user behavior prediction - Social media data analysis (e.g., Twitter, Facebook) - Recommendation systems and personalized content.

UNIT V: Ethical Issues in Social Network Analysis **15 HOURS**

Privacy, security, and consent in social network analysis - Bias and fairness in AI models for social networks - Ethical implications and regulatory concerns (e.g., GDPR).

RECOMMENDED TEXTBOOKS:

1. "Social Network Analysis: Methods and Applications" by Wasserman & Faust
2. "Graph Representation Learning" by William L. Hamilton

REFERENCE BOOKS

1. "Mining the Social Web" by Matthew A. Russell
2. "Social Network Analysis: Methods and Applications" *By Stanley Wasserman and Katherine Faust*

E-LEARNING RESOURCES

1. **https://www.coursera.org/learn/social-network-analysis**
2. **https://graph-neural-networks.github.io/**
3. **https://www.coursera.org/learn/artificial-intelligence-social-media-analytics**

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	**3**	**3**	**3**	**3**	**3**

PSO – CO MAPPING

	PSO 1	**PSO 2**	**PSO 3**
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	2	2
Ave.	**3**	**2.8**	**2.8**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply AI/ML techniques (classification, clustering, GNNs) to analyze social network datasets and achieve performance metrics.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design AI-based solutions for social network problems and validate using real or benchmark datasets.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop graph-based models for community detection and influence propagation.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply AI tools and frameworks to build prototypes for social network analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical, privacy, and bias issues and propose responsible AI strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - II**
COURSE NAME: Blockchain Technology	**COURSE CODE: 26PCAI324**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To empower students with an introduction to blockchain technology, cryptocurrency security, types of cryptocurrency, smart contracts, ICOs, applications, and key aspects of blockchain security.

COURSE OUTCOMES:

1. Apply blockchain frameworks and tools to demonstrate consensus mechanisms and distributed ledgers.
2. Design blockchain-based solutions for real-world applications and validate performance.
3. Develop smart contracts using Ethereum and evaluate functionality through testing.
4. Analyze blockchain platforms such as Bitcoin, Ethereum, and private blockchains.
5. Evaluate security, privacy, and legal challenges and propose mitigation strategies.

UNIT I **15 HOURS**

Origin of Blockchain – Blockchain solution – Components of Blockchain – Block in a Blockchain – Technology and Future – Blockchain Types and Consensus Mechanism: Decentralization and Distribution – Types of Blockchain – Consensus Protocol – Cryptocurrency.

UNIT II **15 HOURS**

Bitcoin, Altcoin and Token: Bitcoin and the Cryptocurrency – Cryptocurrency Basics – Types of Cryptocurrencies – Cryptocurrency usage – Public Blockchain System: Public Blockchain – The Bitcoin Blockchain – Ethereum Blockchain.

UNIT III **15 HOURS**

Smart Contracts: Smart Contract – Characteristics of Smart Contract – Types of Smart Contracts – Types of Oracles – Smart Contracts in Ethereum – Private Blockchain System: Key characteristics – Private Blockchain and Open Source – State Machine – PAXOS, RAFT, Byzantine Fault – Multichain.

UNIT IV **15 HOURS**

Initial Coin Offering: Blockchain Fundraising Methods – Launching an ICO – Investing in an ICO – Pros and Cons of ICO – Evolution of ICO – ICO platforms – Security in Blockchain: Security Aspects – Security and Privacy challenges – Performance and Scalability – Identity Management and Authentication

UNIT V **15 HOURS**

Applications of Blockchain: Blockchain in Banking and Finance – Blockchain in Education – Blockchain in Energy – Blockchain in Healthcare – Blockchain in Real-estate – Blockchain and IoT – Limitations and Challenges of Blockchain.

RECOMMENDED TEXTBOOKS:

1.Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, "Blockchain Technology", Universities Press, 2020

REFERENCE BOOKS:

1. Kumar Saurabh, Ashutosh Saxena "Blockchain Technology Concepts and Applications", Wiley, 2020.
2. Don Tapscott, Alex Tapscott, "Blockchain Revolution" Paperback, 1st Edition, 2018

E-LEARNING RESOURCES

1. https://www.javatpoint.com/blockchain-tutorial
2. https://www.tutorialspoint.com/blockchain/index.html

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	2	2	2	2	2
Ave.	2.8	2.8	2.8	2.8	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	2	2	2
Ave.	2.8	2.8	2.8

PO – PSO – CO QUESTION PAPER MAPPING

CO No	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply blockchain frameworks and tools to demonstrate consensus mechanisms and distributed ledgers.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design blockchain-based solutions for real-world applications and validate performance.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop smart contracts using Ethereum and evaluate functionality through testing.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Analyze blockchain platforms such as Bitcoin, Ethereum, and private blockchains.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate security, privacy, and legal challenges and propose mitigation strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - III**
COURSE NAME: Probability and Statistics	**COURSE CODE: 26PCAM312**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To understand the concepts of Probability one dimensional, two dimensional random variables and testing hypothesis, multivariable analysis.

COURSE OUTCOMES:

1. Explain fundamental probability concepts including axioms, conditional probability, and Bayes' theorem; analyze standard distributions.
2. Develop joint distributions and analyze marginal and conditional distributions of random variables.
3. Analyze relationships using regression and correlation; apply statistical estimation techniques.
4. Explain relationships using regression and correlation; apply estimation methods including MLE and moments.
5. Develop random vectors and matrices using mean and covariance; analyze multivariate normal distribution.

UNIT I **15 HOURS**

PROBABILITY AND RANDOM VARIABLES

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II **15 HOURS**

TWO DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Functions of two-dimensional random variables – Regression curve – Correlation.

UNIT III **15 HOURS**

ESTIMATION THEORY CORRELATION AND LINES OF REGRESSION

Regression Curve – Correlation. Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV **15 HOURS**

TESTING OF HYPOTHESIS

Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V **15 HOURS**

MULTIVARIATE ANALYSIS

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

RECOMMENDED TEXTBOOKS:

1. Treatment and content as in "Statistical Methods" – S.P. Gutpa,Sultan Chand & Sons 45th Edition(2017).
2. Dallas E. Johnson, ―Applied Multivariate Methods for Data Analysis

REFERENCE BOOKS:

1. New Mathematical statistics - Sanjay Arora & Bansilal (2002), Meerat Publications, New Delhi
2. Fundamentals of Mathematical Statistics - Gupta,S.C. and Kapoor, V.K.(2000): 10/e, Sultan Chand & Sons
3. Basic Statistics - 3/Agarwal .B.L (1996): e ,New Age International(P) Ltd.,
4. Statistics for Business and Economics - Hooda.R.P.(2003): 3/e, MacMillan.
5. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers ", Pearson Education, Asia, 8th Edition, 2015.

E-LEARNING RESOURCES:

1. https://nptel.ac.in/courses/111105090
2. https://nptel.ac.in/courses/110104440
3. https://nptel.ac.in/courses/111105091

GUIDELINES TO THE QUESTION PAPER
SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	2	3	3	3	3
CO 2	3	2	3	3	2
CO 3	3	3	3	2	3
CO 4	2	3	3	3	3
CO 5	3	3	2	3	3
Ave.	2.6	2.8	2.8	2.8	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	2	3
CO 2	3	3	3
CO 3	3	2	3
CO 4	2	3	3
CO 5	3	3	2
Ave.	2.8	2.6	2.8

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain fundamental probability concepts including axioms, conditional probability, and Bayes' theorem; analyze standard distributions.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop joint distributions and analyze marginal and conditional distributions of random variables.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Analyze relationships using regression and correlation; apply statistical estimation techniques.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Explain relationships using regression and correlation; apply estimation methods including MLE and moments.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop random vectors and matrices using mean and covariance; analyze multivariate normal distribution.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Problem solving sessions	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - III**
COURSE NAME: Statistics for Artificial Intelligence	**COURSE CODE: 26PCAM325**
SEMESTER: II	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 75**
THEORY	

COURSE OBJECTIVE:

To equip students with fundamental statistical concepts and techniques essential for data-driven decision-making in artificial intelligence.

COURSE OUTCOMES:

1. Perform data visualization using histograms, boxplots, and heatmaps; apply preprocessing techniques.
2. Explain probability concepts including axioms, conditional probability, and Bayes' theorem; analyze distributions.
3. Apply sampling distributions and hypothesis testing, including Type I and Type II errors.
4. Analyze relationships between variables using regression and correlation.
5. Develop Bayesian concepts and analyze Bayesian networks; develop Naive Bayes for applications.

UNIT I **15 HOURS**

Types of Data – Central Tendency (Mean, Median, Mode) – Dispersion (Range, Variance, Standard Deviation, IQR) – Data Visualization (Histogram, Boxplot, Heatmap) – Data Preprocessing.

UNIT II **15 HOURS**

Probability Rules – Conditional Probability – Bayes' Theorem – Discrete Distributions (Binomial, Poisson) – Continuous Distributions (Normal, Exponential) – Expected Value – Variance – Central Limit Theorem.

UNIT III **15 HOURS**

Sampling – Point Estimation – Confidence Intervals – Hypothesis Testing (z-test, t-test, chi-square test, ANOVA) – p-value – Confidence Level – Type I and Type II Errors.

UNIT IV **15 HOURS**

Correlation – Simple Linear Regression – Multiple Linear Regression – Model Assumptions – Multicollinearity – Residual Analysis – Cross-Validation – Model Evaluation (MSE, RMSE, R^2).

UNIT V **15 HOURS**

Bayesian vs Frequentist – Prior – Likelihood – Posterior – Bayesian Inference – Bayesian Networks – Probabilistic Graphical Models – Naive Bayes – Applications in AI.

RECOMMENDED TEXTBOOKS:

1. All of Statistics – Larry Wasserman
2. An Introduction to Statistical Learning – Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
3. Bayesian Reasoning and Machine Learning – David Barber

REFERENCE BOOKS:

1. All of Statistics: A Concise Course in Statistical Inference – Larry Wasserman
2. An Introduction to Statistical Learning – Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani
3. Pattern Recognition and Machine Learning – Christopher M. Bishop

E-LEARNING RESOURCES

1. StatQuest with Josh Starmer (YouTube)
2. Khan Academy – Statistics and Probability
3. MIT OpenCourseWare – Introduction to Probability and Statistics

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	2	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	2	3	3
CO 5	3	3	3	3	2
Ave.	3	2.8	2.8	2.8	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	2	3
CO 2	3	3	3
CO 3	3	2	3
CO 4	2	3	3
CO 5	3	3	2
Ave.	2.8	2.6	2.8

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Perform data visualization using histograms, boxplots, and heatmaps; apply preprocessing techniques.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Explain probability concepts including axioms, conditional probability, and Bayes' theorem; analyze distributions.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Apply sampling distributions and hypothesis testing, including Type I and Type II errors.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Analyze relationships between variables using regression and correlation.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop Bayesian concepts and analyze Bayesian networks; develop Naive Bayes for applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Problem solving sessions	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: B	**COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS - II**
COURSE NAME: Quantitative Aptitude	**COURSE CODE: 26PGSL404**
SEMESTER: II	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVE

To improve the Quantitative Aptitude skills of the Students.

COURSE OUTCOMES:

1. Examine and evaluate problems based on mathematical concepts like Numbers,HCF, LCM, Decimal Fractions, Simplification, Square Roots, Cube roots, Averages
2. Examine and evaluate problems based on numbers and ages, Surds, Indices, Percentages, Profit and Loss, Ratio and Proportion, Partnership, Chain Rule.
3. Examine and evaluate problems based on Time and Work, Pipes and Distances. Time and distance, Problems on Trains.
4. Examine and evaluate problems problems based on Boats and Streams, Alligation, Simple Interest, Compound Interest, Logarithms, Area, Volume and Surface Area.
5. Analyze the given problem related to Quantitative Aptitude and solve it efficiently.

UNIT I **6 HOURS**

Numbers, HCF, LCM, Decimal Fractions, Simplification, Square Roots, Cube roots, Averages.

UNIT II **6 HOURS**

Problems in numbers and ages, Surds, Indices, Percentages, Profit and Loss, Ratio and Proportion, Partnership, Chain Rule.

UNIT III: **6 HOURS**

Time and Work, Pipes and Distances. Time and distance, Problems on Trains.

UNIT IV **6 HOURS**

Boats and Streams, Alligation, Simple Interest, Compound Interest, Logarithms, Area, Volume and Surface Area.

UNIT V **6 HOURS**

Races and Games of Skill, Calendar, Clocks, Stocks and Shares, Permutation and Combination, Probability, True discount, Banker's Discount, Height and Distances, Old man out and Series, Tabulation, Bar graphs, Pie charts, Line Graphs.

RECOMMENDED TEXTBOOKS:

1. R.S. Aggarwal, "Quantitative Aptitude for Competitive Examinations", Seventh Revised Edition, S. Chand and Co. Ltd., New Delhi, 2005.
2. Satish Kumar “Maths in Moments Quantitative Aptitude for Competitive Exams” Arihant publications (India) Limited

REFERENCE BOOKS:

1. Shweta Arora, “Formulae & Tricks Quantitative Aptitude Book For CAT | XAT | MAT | Entrance & Government Job (MBA Exam)”

Question Paper pattern : MCQ

SEMESTER III

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - X**
COURSE NAME: Deep Learning	**COURSE CODE: 26PCAI313**
SEMESTER: III	**MARKS: 100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To understand the fundamentals and applications of Deep Learning techniques, including CNN, RNN, LSTM, GANs, and Auto-encoders, and their use in solving real-world problems.

COURSE OUTCOMES

1. Explain deep learning concepts including neural networks, backpropagation, and optimization.
2. Design deep feedforward and convolutional neural networks using TensorFlow and PyTorch.
3. Analyze recurrent neural networks such as RNN, LSTM, and GRU for sequential data.
4. Develop and evaluate generative models including GANs.
5. Develop and evaluate autoencoders and hybrid models for compression and feature learning.

UNIT I **12 HOURS**

INTRODUCTION TO DEEP LEARNING: Historical Trends in Deep Learning, Why DL is Growing, Artificial Neural Network, Non-linear classification example using Neural Networks: XOR/XNOR, Single/Multiple Layer Perceptron, Feed Forward Network, Deep Feed- forward networks, Stochastic Gradient–Based learning, Hidden Units, Architecture Design, Back- Propagation, Deep learning frameworks and libraries (e.g., TensorFlow/Keras, PyTorch).

UNIT II **12 HOURS**

CONVOLUTION NEURAL NETWORK (CNNd: Introduction to CNNs and their applications in computer vision, CNN basic architecture, Activation functions-sigmoid, tanh, ReLU, Softmax layer, Types of pooling layers, Training of CNN in TensorFlow, various popular CNN architectures: VGG, Google Net, ResNet etc, Dropout, Normalization, Data augmentation

UNIT III **12 HOURS**

RECURRENT NEURALNETWORK(RNN): Introduction to RNNs and their applications in sequential data analysis, Back propagation through time (BPTT), Vanishing Gradient Problem, gradient clipping Long Short Term Memory (LSTM) Networks, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs.

UNIT IV **12 HOURS**

GENERATIVE ADVERSARIAL NETWORKS (GANS): Generative models, Concept and principles of GANs, Architecture of GANs (generator and discriminator networks), Comparison between discriminative and generative models, Generative Adversarial Networks (GANs), Applications of GANs.

UNIT V **12 HOURS**

AUTO-ENCODERS: Auto-encoders, Architecture and components of autoencoders (encoder and decoder), Training an auto-encoder for data compression and reconstruction, Relationship between Autoencoders and GANs, Hybrid Models: Encoder- Decoder GANs.

RECOMMENDED TEXTBOOKS:

1. Deep Learning: An MIT Press Book by Ian Goodfellow and Yoshua Bengio Aaron Courville.
2. Michael Nielson, Neural Networks and Deep Learning, Determination Press,2015.
3. Satishkumar, Neural networks: A classroom Approach, Tata McGraw-Hill Education,2004

REFERENCE BOOKS:

1. Deep Learning with Python, Francois Chollet, Manning publications 2018
2. Advanced Deep Learning with Keras, Rowel Atienza, PACKT Publications 2018

E-LEARNING RESOURCES

1. Deep Learning Specialization – Andrew Ng (Coursera)
2. Fast.ai Practical Deep Learning for Coders
3. Deep Learning with Python – GitHub (François Chollet)

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer all the questions	1-10	2	20
B	Answer any 5 out of 7 questions	11-17	7	35
C	Answer any 3 out of 5 questions(each in 1200 words)	18-22	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	1	1
III	2	2	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	2	3
CO 5	3	3	3	3	3
Ave.	3	3	3	2.8	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain deep learning concepts including neural networks, backpropagation, and optimization.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design deep feedforward and convolutional neural networks using TensorFlow and PyTorch.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Analyze recurrent neural networks such as RNN, LSTM, and GRU for sequential data.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Develop and evaluate generative models including GANs.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop and evaluate autoencoders and hybrid models for compression and feature learning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - XI**
COURSE NAME: Natural Language Processing	**COURSE CODE: 26PCAI314**
SEMESTER: III	**MARKS: 100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To understand algorithms for processing linguistic information, gain knowledge in morphological, syntactic, and semantic NLP tasks, familiarize with NLP tools and datasets, develop systems for NLP problems, and learn to create machine learning models and generative AI.

COURSE OUTCOMES

1. Apply NLP techniques (N-grams, HMMs, neural models) to process text and evaluate performance.
2. Design NLP solutions for applications such as machine translation and information extraction.
3. Develop advanced NLP models including LSTM, parsing, and semantic analysis.
4. Develop NLP pipelines using NLTK, spaCy, and Transformers.
5. Evaluate ethical issues in NLP and propose responsible AI strategies.

UNIT I **12 HOURS**

INTRODUCTION: Introduction - NLP tasks in syntax, semantics, and pragmatics. Applications such as information extraction, question answering, and machine translation. The problem of ambiguity. The role of machine learning. Brief history of the field - N-gram Language Models - The role of language models. Simple N- gram models. Estimating parameters and smoothing. Evaluating language models.

UNIT II **12 HOURS**

BASIC NLP TECHNIQUES: Part Of Speech Tagging and Sequence Labeling - Lexical syntax. Hidden Markov Models (Forward and Viterbi algorithms and EM training) - Basic Neural Networks. Any basic introduction to perceptron and back propagation.

UNIT III **12 HOURS**

PARSING & SEMANTIC ANALYSIS: LSTM Recurrent Neural Networks -Syntactic parsing - Grammar formalisms and treebanks. Efficient parsing for context-free grammars (CFGs). Statistical parsing and probabilistic CFGs (PCFGs). Lexicalized PCFGs. Neural shift-reduce dependency parsing - Lexical semantics and word-sense disambiguation. Compositional semantics. Semantic Role Labelling and Semantic Parsing.

UNIT IV **12 HOURS**

GENERATIVE AI USES, APPLICATIONS AND TOOLS: Introduction to Generative AI – Generative AI capabilities – Generative AI uses and applications across industries – Generative text and speech models – Generative image models – Generative AI models - Generative Adversarial Networks (GANs) - Variational auto encoders (VAEs).

UNIT V **12 HOURS**

MACHINE TRANSLATION: Information Extraction (IE) - Named entity recognition and relation extraction. IE using sequence labelling. -Machine Translation (MT) Basic issues in MT. Statistical translation, word alignment, phrase-based translation, and synchronous grammars.

RECOMMENDED TEXTBOOKS:

1. Jurafsky Dan and Martin James H. "Speech and Language Processing" ,3rd Edition, 2018.
2. Learn Python Generative AI: Journey from autoencoders to transformers to large language models, Zonunfeli Ralte, Indrajit Kar, BPB Publications, 2024

REFERENCE BOOKS:

1. Sowmya Vajjala, Bodhisattwa Majumder, Anuj Gupta, Harshit Surana, Practical Natural Language Processing, 2020.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, 2009.
3. Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models, Packt publishing, 2021.

E-LEARNING RESOURCES

1. https://onlinecourses.nptel.ac.in/noc19_cs56/preview
2. https://www.edx.org/learn/natural-language-processing
3. https://www.coursera.org/specializations/natural-language-processing
4. https://www.tutorialspoint.com/natural_language_processing/index.htm
5. https://www.geeksforgeeks.org/generative-ai-models/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	Answer all the questions	1-10	2	20
B	Answer any 5 out of 7 questions	11-17	7	35
C	Answer any 3 out of 5 Questions (each in 1200 words)	18-22	15	45
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	2	3
CO 5	3	3	3	3	3
Ave.	3	3	3	2.8	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply NLP techniques (N-grams, HMMs, neural models) to process text and evaluate performance.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design NLP solutions for applications such as machine translation and information extraction.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop advanced NLP models including LSTM, parsing, and semantic analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Develop NLP pipelines using NLTK, spaCy, and Transformers.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical issues in NLP and propose responsible AI strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - XII**
COURSE NAME: Full Stack Development	**COURSE CODE: 26PCAI315**
SEMESTER: III	**MARKS: 100**
CREDITS: 4	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVES

To provide extensive skill to build, deploy, and secure full-stack web applications using React.js for the front-end, Node.js for the back-end, cloud platforms for deployment, Docker for consistency, and implement best practices for testing and authentication.

COURSE OUTCOMES

1. Apply modern web technologies (HTML, CSS, JavaScript, React, Node.js) to build full-stack applications.
2. Design scalable web applications for real-world problems.
3. Develop full-stack solutions using microservices, APIs, and database integration.
4. Apply tools such as Git, Docker, and CI/CD pipelines for development and deployment.
5. Evaluate and develop security measures ensuring ethical and secure practices.

UNIT I **12 HOURS**

Introduction to Full Stack Development & Front-End Development: Overview of Full Stack Development: Role of Front-end, Back-end, and Database in web applications - Understanding modern web stacks (MEAN, MERN) - - Setting up the Development Environment - Installing Node.js, npm (Node Package Manager) - Using version control with Git and GitHub - Introduction to development tools and IDEs (VS Code, Postman, etc.) Basics of Web Development - HTML5 and CSS3 fundamentals - HTML5 & CSS3 for Web Design - Structuring pages with HTML5 (forms, tables, multimedia) - Advanced CSS techniques (Flexbox, Grid, animations, and transitions).

UNIT II **12 HOURS**

Front-End Development: JavaScript fundamentals (variables, loops, functions) - JavaScript and DOM Manipulation (selecting, updating elements) - Event handling and user input validation - React.js (for MERN Stack) - Introduction to React.js: Components, JSX, Props, and State- React Hooks: useState, useEffect - React Router for navigating between pages - Managing global state with Redux or React Context API - Managing global state with React.

UNIT III **12 HOURS**

Back-End Development: Node.js Fundamentals – Definition of Node.js –Working as a JavaScript runtime for server-side development - Handling HTTP requests and responses in Node.js - Introduction to

asynchronous programming in Node.js: Callbacks, Promises, and async/await; Express.js for Building APIs - Setting up a Node.js server using Express.js - Building RESTful APIs: Understanding GET, POST, PUT, and DELETE requests - Using Express middleware for tasks like error handling, logging, and authentication - Working with MongoDB: Introduction - Performing CRUD operations (Create, Read, Update, Delete) with MongoDB - Using Mongoose, an ODM (Object Data Modeling) library, to work with MongoDB - User Authentication; Introduction to JWT (JSON Web Tokens) for user authentication and managing secure access - Implementing login and registration systems using JWT - Securing routes and API endpoints to ensure only authorized users can access them.

UNIT IV **12 HOURS**

Advanced Concepts and Tools: Microservices Architecture – Introduction to Microservices: Breaking down a large application into smaller, independent services - Communication between microservices using APIs and message queues - Benefits of microservices for scaling and maintaining large applications; Docker for Containerization - Introduction to Docker - Dockerizing full-stack applications – Wrapping back-end and front-end in containers - Docker Compose for defining and running multi-container applications; Performance Optimization - Techniques - Redis for caching data to reduce database load - Optimizing React applications with lazy loading and code splitting; Scalability - Techniques to scale application, such as load balancing, clustering, and horizontal.

UNIT V **12 HOURS**

Deployment, Testing, and Security: Deployment: Deploying full-stack application on cloud platforms like Heroku, AWS, or DigitalOcean - Setting up CI/CD pipelines for automated testing and deployment - Using Docker for consistent deployment across environments (development, staging, production); Testing Applications: Unit Testing, Integration Testing, and End-to-End Testing - Testing Node.js APIs using Jest - Testing React applications with Jest and React Testing Library; Security: Protecting from common security vulnerabilities (e.g., Cross-Site Scripting (XSS), SQL Injection, Cross-Site Request Forgery (CSRF)) - Using HTTPS and SSL certificates for secure communication - Implementing user authentication securely using JWT and OAuth; Monitoring and Logging: Monitoring application with tools like PM2 - Setting up logging for errors and debugging using tools like or Morgan.

RECOMMENDED TEXTBOOKS:

1. "Full Stack JavaScript Development with MEAN" by Colin J. Ihrig
2. "Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node" by Vasan Subramanian
3. "Learning JavaScript Design Patterns" by Addy Osmani
4. "Node.js Design Patterns" by Mario Casciaro
5. "Docker Deep Dive" by Nigel Poulton

REFERENCE BOOKS

1. "You Don't Know JS" (Series) by Kyle Simpson
2. "JavaScript: The Good Parts" by Douglas Crockford
3. "Learning React" by Alex Banks and Eve Porcello
4. "Eloquent JavaScript" by Marijn Haverbeke
5. "Node.js Design Patterns" by Mario Casciaro

E-LEARNING RESOURCES

1. https://fullstackopen.com/en/
2. https://www.coursera.org/specializations/mern-stack-front-to-back
3. https://www.codecademy.com/learn/paths/full-stack-engineer-career-path

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	2	3
CO 5	3	3	3	3	3
Ave.	3	3	3	2.8	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply modern web technologies (HTML, CSS, JavaScript, React, Node.js) to build full-stack applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design scalable web applications for real-world problems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop full-stack solutions using microservices, APIs, and database integration.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply tools such as Git, Docker, and CI/CD pipelines for development and deployment.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate and develop security measures ensuring ethical and secure practices.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE – XIII**
COURSE NAME: PRACTICAL - V: Deep Learning Lab	**COURSE CODE: 26PCAI316P**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
PRACTICAL	

COURSE OBJECTIVE

To understand the fundamentals and applications of Deep Learning techniques, including CNN, RNN, LSTM, GANs, and Auto-encoders, and their use in solving real-world problems.

COURSE OUTCOMES

1. Explain deep learning concepts, including neural networks, activation functions, and backpropagation.
2. Design feedforward and convolutional neural networks using TensorFlow and Keras.
3. Analyze sequential models such as RNN, LSTM, and Bidirectional LSTM.
4. Develop generative models, including GANs.
5. Develop autoencoders and their variants for image compression, reconstruction, denoising, and feature learning.

Lab Exercises

1. Implement a single-layer perceptron for classifying AND and OR logic gates and demonstrating the XOR limitation.
2. Design a Multi-Layer Perceptron (MLP) using Keras for MNIST digit classification.
3. Implement the backpropagation algorithm with Stochastic Gradient Descent (SGD) for training a neural network.
4. Design a Convolutional Neural Network (CNN) with two convolutional layers for Fashion MNIST image classification.
5. Apply data augmentation techniques using Keras for CNN-based image classification on the CIFAR-10 dataset.
6. Evaluate pretrained VGG16 and ResNet models for CIFAR-10 image classification.
7. Develop a Recurrent Neural Network (RNN) model for sentiment analysis using the IMDB dataset.
8. Develop a LSTM-based model for sentiment classification using the IMDB dataset.
9. Implement a Bidirectional LSTM model for sequential data classification.
10. Develop a Generative Adversarial Network (GAN) for generating handwritten digit images using the MNIST dataset.
11. Implement a Deep Convolutional GAN (DCGAN) for image generation.
12. Develop a Conditional GAN (cGAN) for controlled image generation.

13. Develop an autoencoder for image compression and reconstruction using the MNIST dataset.
14. Implement a denoising autoencoder for reconstructing noisy images.
15. Develop an Encoder–Decoder GAN model for image reconstruction.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain deep learning concepts, including neural networks, activation functions, and backpropagation.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design feedforward and convolutional neural networks using TensorFlow and Keras.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Analyze sequential models such as RNN, LSTM, and Bidirectional LSTM.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Develop generative models, including GANs.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop autoencoders and their variants for image compression, reconstruction, denoising, and feature learning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - XIV**
COURSE NAME: PRACTICAL – VI: Natural Language Processing Lab	**COURSE CODE: 26PCAI317P**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
PRACTICAL	

COURSE OBJECTIVE:

To learn how computers understand and process language using algorithms, tools, and AI models.

COURSE OUTCOMES:

1. Apply basic NLP preprocessing and text analysis techniques for natural language data.
2. Implement NLP methods for language modeling, tagging, classification, and information extraction tasks.
3. Develop machine learning and neural network based NLP applications using suitable tools and libraries.
4. Construct NLP solutions for parsing, topic modeling, speech processing, and machine translation.
5. Design and demonstrate Generative AI and NLP applications for real-world language processing problems.

Lab Exercises

1. Implement word tokenizer, sentence tokenizer, and paragraph tokenizer for a given text.
2. Write a program to perform text preprocessing operations such as case conversion, stopword removal, punctuation removal, and text normalization.
3. Implement various stemming and lemmatization techniques and compare their outputs for the given text.
4. Write a program to generate:
   (a) Uni-grams
   (b) Bi-grams
   (c) Tri-grams
   (d) N-grams
   using both user-defined and predefined functions.
5. Write a program to implement TF-IDF for a given corpus.
6. Illustrate Part-of-Speech tagging and chunking for user-defined text and corpus data.
7. Implement Named Entity Recognition (NER) to identify entities such as person, organization, and location names from the given text.
8. Write a program to implement a basic Hidden Markov Model (HMM) for Part-of-Speech tagging.

9. Implement a basic neural network model for text classification.
10. Write a program to implement Context Free Grammar (CFG) parsing and generate parse trees for the given sentences.
11. Implement Latent Semantic Analysis (LSA) and Topic Modeling for the given text corpus.
12. Implement text classification using:
    (a) Naïve Bayes
    (b) Support Vector Machine (SVM)
13. Implement a Generative AI application for text generation, summarization, question answering, or chatbot response generation.
14. Convert the given text to speech and speech to text using suitable NLP libraries.
15. Implement Machine Translation and Information Extraction techniques for the given text.

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Develop NLP techniques (tokenization, POS tagging, NER) and evaluate performance.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop NLP solutions such as text classification and speech processing.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Design advanced NLP models including TF-IDF, clustering, and topic modeling.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply NLP tools and programming for lab experiments and mini-projects.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical issues in NLP and propose mitigation strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Practical examination with programming/problem-solving tasks for 90 minutes	50	10
Model Examination	Practical examination with programming/problem-solving tasks for 180 minutes	100	10
Assignment	Assignment based on experimental concepts	10	5
Workbook/record book/ notebook	Handwritten record of experiments, observations, results, and conclusions	10	5
Class activity 1	Debugging Test	5	5
Class activity 2	Problem-Solving Exercise	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - IV**
COURSE NAME: AI in Healthcare	**COURSE CODE:**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To explore the significance of AI and ML in healthcaAre, study advanced algorithms, computational intelligence techniques, and NLP applications. Additionally, understand evaluation metrics, ethics, and the future scope of AI/ML in healthcare innovations.

COURSE OUTCOMES

1. Explain the concepts of AI, ML, and DL and their applications in healthcare systems.
2. Apply AI/ML techniques for healthcare data analysis, prediction, and clinical decision support.
3. Design and evaluate healthcare AI models using appropriate metrics, validation methods, and performance tuning techniques.
4. Develop healthcare NLP applications using clinical data, EHRs, and modern NLP tools.
5. Analyze and develop AI-driven healthcare solutions by incorporating emerging technologies, ethical considerations, and societal impact.

UNIT I **12 HOURS**

Introduction to AI in Healthcare: Overview of AI in healthcare, Healthcare ecosystem and challenges, Applications of AI in healthcare – disease prediction, diagnosis, personalized treatment, behavior modification, drug discovery, clinical decision support and follow-up care, Realizing the potential of AI in healthcare, Healthcare data sources and characteristics, Healthcare use cases.

UNIT II **12 HOURS**

AI Applications in Healthcare: Knowledge discovery and data mining in healthcare, Healthcare analytics, Clinical decision support systems, AI applications in disease prediction and risk assessment, Medical imaging applications, Multi-agent infectious disease propagation and outbreak prediction, Automated screening systems, Patient monitoring and healthcare management applications, Case studies.

UNIT III **12 HOURS**

Development and Evaluation of Healthcare AI Systems: Model development workflow, Data preparation and preprocessing, Training, validation and testing, Evaluation metrics for healthcare

applications, Hyperparameter tuning concepts, Model performance analysis, Challenges in healthcare AI deployment, Ethics, fairness, transparency, privacy and security in healthcare AI.

UNIT IV **12 HOURS**

Natural Language Processing in Healthcare: NLP tasks in medicine, Low-level NLP components, High-level NLP components, NLP methods, Clinical NLP resources and tools, Electronic Health Records (EHR) analysis, NLP applications in healthcare, Model interpretability using Explainable AI for healthcare applications.

UNIT V **12 HOURS**

Emerging Trends in AI-Driven Healthcare: Evidence-based medicine, Personalized medicine, Connected medicine, Digital health and therapeutics, Conversational AI in healthcare, Virtual and Augmented Reality applications, Blockchain for healthcare data management, Robot-assisted surgery, Smart hospitals, Case studies on AI and ML for disease risk diagnosis and healthcare analytics.

RECOMMENDED TEXTBOOKS:

1. Arjun Panesar, Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, 2nd Edition, Apress, 2023.
2. Parag Mahajan and Suchita Vaidya, Artificial Intelligence in Healthcare, Springer Nature Singapore, 2020.

REFERENCE BOOKS

1. Arvin Agah (Ed.), Medical Applications of Artificial Intelligence, CRC Press, 2013. (Classic reference; retain for foundational medical AI applications.)
2. Ankur Saxena and Utku Kose (Eds.), Artificial Intelligence for Healthcare Applications and Management, IGI Global, 2021.
3. Ton J. Cleophas and Aeilko H. Zwinderman, Machine Learning in Medicine: A Complete Overview, 2nd Edition, Springer, 2023.
4. Erik R. Ranschaert, Sergey Morozov and Paul R. Algra (Eds.), Artificial Intelligence in Medical Imaging: Opportunities, Applications and Risks, Springer, 2019.
5. Sergio Consoli, Diego Reforgiato Recupero and Milan Petković (Eds.), Data Science for Healthcare: Methodologies and Applications, Springer, 2019.

E-LEARNING RESOURCES

1. AI for Medicine Specialization (Coursera)
2. AI for Healthcare Specialization (Coursera)
3. Stanford AIMI (Artificial Intelligence in Medicine and Imaging)
4. WHO Ethics and Governance of AI for Health
5. MIT Deep Learning for Healthcare Lectures

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**3.0**	**3.0**	**3.0**	**3.0**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**3.0**	**3.0**	**3.0**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	**COURSE OUTCOMES**	**POs ADDRESSED**	**PSOs ADDRESSED**	**COGNITIVE LEVEL (K1 to K6)**
CO1	Explain AI, ML, and DL roles in healthcare systems and applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Apply AI/ML techniques for healthcare data analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Design and evaluate intelligent models using metrics and tuning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Develop NLP applications for healthcare using modern tools.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Develop AI-based solutions for healthcare considering ethics and societal impact.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - IV**
COURSE NAME: AI for Economics and Finance	**COURSE CODE:**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVES

To skill the students to apply AI/ML techniques for financial prediction, risk management, fraud detection, and economic forecasting.

COURSE OUTCOMES

1. Explain AI and ML concepts for financial data analysis.
2. Apply machine learning and time series models for financial prediction and optimization.
3. Design and evaluate AI models for risk management and fraud detection.
4. Integrate econometric methods with machine learning for predictive modeling.
5. Evaluate ethical and regulatory issues in AI-driven financial systems.

UNIT I **12 HOURS**

Introduction to AI and Machine Learning: Introduction to AI and ML - Supervised vs unsupervised learning - Common ML algorithms: Linear regression, decision trees, clustering - Data preprocessing, feature engineering, and model evaluation

UNIT II **12 HOURS**

Machine Learning in Finance and Economic Data Analysis Time series analysis: ARIMA and LSTM models - Stock price prediction and market forecasting using machine learning - Portfolio optimization with machine learning - Economic modelling using machine learning.

UNIT III **12 HOURS**

AI in Risk Management and Fraud Detection Risk modelling with AI: Value-at-risk (VaR) and credit risk prediction - Detecting fraud and anomalies using machine learning - Derivatives pricing and options modelling using ML - Stress testing portfolios with AI.

UNIT IV **12 HOURS**

Integrating Econometrics and AI: Econometrics basics: Ordinary Least Squares (OLS), Generalized Method of Moments (GMM) - Integrating econometrics with machine learning - Macroeconomic forecasting using AI - Causal inference using machine learning.

UNIT V **12 HOURS**

Ethical Considerations and Real-World Applications: Ethical concerns in AI: Bias, fairness, transparency - AI in algorithmic trading, robo-advisors, and RegTech - Regulatory aspects and the future of AI in finance.

TEXT BOOKS

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell & Peter Norvig
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
3. "Machine Learning for Asset Managers" by Marcos López de Prado
4. "Econometrics and Data Analysis for Developing Countries" by Thomas L. Friedman
5. "Hands-On Machine Learning for Algorithmic Trading" by Stefan Jansen

REFERENCE BOOKS

1. Advances in Financial Machine Learning – Marcos López de Prado.
2. The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman.
3. Econometric Analysis – William H. Greene

E-LEARING RESOURCES

1. **AI For Everyone in Finance – Coursera (by Andrew Ng & DeepLearning.AI)**
   https://www.coursera.org/learn/ai-for-everyone-in-finance
2. **Financial Engineering and Risk Management – Columbia University (Coursera)**
   https://www.coursera.org/specializations/financial-engineering-risk-management
3. **Machine Learning for Trading – Udacity (by Georgia Tech)**
   https://www.udacity.com/course/machine-learning-for-trading--ud501

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**3.0**	**3.0**	**3.0**	**3.0**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	2	3	3
Ave.	**2.8**	**3.0**	**3.0**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Explain AI and ML concepts for financial data analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Apply machine learning and time series models for financial prediction and optimization.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Design and evaluate AI models for risk management and fraud detection.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Integrate econometric methods with machine learning for predictive modeling.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical and regulatory issues in AI-driven financial systems.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - IV**
COURSE NAME: AI in Agriculture	**COURSE CODE: 26PCAI318**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To educate the applications of AI in agriculture, including machine learning, data collection, precision farming, automation, ethical issues, and sustainable practices to solve real-world challenges.

COURSE OUTCOMES

1. Apply AI/ML tools and sensing technologies to analyze agricultural data for precision farming.
2. Develop AI models for crop prediction, yield forecasting, disease detection, and soil analysis.
3. Create AI-driven solutions for agricultural automation to improve efficiency.
4. Integrate AI technologies to design scalable solutions for agricultural challenges.
5. Evaluate ethical, environmental, and societal implications of AI in agriculture.

UNIT I **12 HOURS**

Introduction to AI and Agriculture: AI role in agriculture - AI concepts - machine learning - deep learning - computer vision - crop prediction - resource management – sustainability.

UNIT II **12 HOURS**

Data Collection and Sensing Technologies in Agriculture: Data collection - sensing technologies - sensor data - satellite imagery - IoT devices - precision agriculture - drones - remote sensing - GPS - environmental sensors.

UNIT III **12 HOURS**

Machine Learning and AI Models in Agriculture: Machine learning - AI models - supervised learning - unsupervised learning - crop prediction - yield forecasting - plant disease detection - pest detection - soil analysis.

UNIT IV **12 HOURS**

AI-Driven Automation in Agricultural Practices: AI-driven automation - autonomous machinery - drones - tractors - harvesters - Robotic systems - weeding - planting - harvesting - precision irrigation - livestock monitoring.

UNIT V **12 HOURS**

Ethical, Environmental &Future Perspectives of AI in Agriculture: Ethical issues - data privacy - bias - decision-making transparency - environmental impact - sustainable farming practices - climate change mitigation - future trends - smart farming - vertical farming.

RECOMMENDED TEXTBOOKS:

1. Dionysis Bochtis, Dimitrios Moshou and Klaus Sørensen, *Artificial Intelligence in Agriculture*, Academic Press, Elsevier, 2022.
2. K. G. Srinivasa, G. M. Siddesh and Hanumanthappa M., *Artificial Intelligence in Agriculture*, Springer, 2018.

REFERENCE BOOKS

1. Manoj Kumar Jhariya et al., *Artificial Intelligence for Sustainable Agriculture*, CRC Press, 2021.
2. Rupesh Kumar Srivastava et al., *Internet of Things and Artificial Intelligence for Smart Agriculture*, Wiley, 2022.
3. S. Balamurugan et al., *Smart Agriculture Automation Using Advanced Technologies*, Wiley-Scrivener, 2021.
4. Aurélien Géron, *Hands-On Machine Learning with Scikit-Learn, Keras and TensorFlow*, 3rd Edition, O'Reilly Media, 2022.

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	2	3	3	3	3
Ave.	**2.8**	**3.0**	**3.0**	**3.0**	**2.8**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	**3.0**	**3.0**	**3.0**

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply AI/ML tools and sensing technologies to analyze agricultural data for precision farming.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop AI models for crop prediction, yield forecasting, disease detection, and soil analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Create AI-driven solutions for agricultural automation to improve efficiency.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Integrate AI technologies to design scalable solutions for agricultural challenges.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical, environmental, and societal implications of AI in agriculture.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE – V**
COURSE NAME: Network Security and Cryptography	**COURSE CODE: 26PCAI319**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To provide foundational knowledge of cryptographic techniques, network and system security, digital forensics, and cyber laws to ensure data privacy and secure communication.

COURSE OUTCOMES

1. Apply cryptographic algorithms (AES, RSA, ECC) to secure data and verify correctness.
2. Design secure communication systems using authentication and encryption techniques.
3. Develop and analyze network security mechanisms such as firewalls and intrusion detection.
4. Apply cybersecurity tools and practices through case studies and audits.
5. Evaluate legal, ethical, and privacy issues and propose secure solutions.

UNIT I **12 HOURS**

Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

UNIT II **12 HOURS**

Computer Forensics Systems and Evidence Collection - Public-key Cryptosystem Introduction to Number Theory – RSA Algorithm – Key Management – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography Message Authentication and Hash Functions – Hash and MAC Algorithm – Digital Signatures and Authentication Protocol. Cyber Law, Data Privacy, and Security.

UNIT III **12 HOURS**

Network Security Practice: Authentication Applications – Kerberos – X.509 Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.

UNIT IV **12 HOURS**

Web Security – Secure Socket Layer –Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls – Password Security.

UNIT V **12 HOURS**

Case Study: Implementation of Cryptographic Algorithms – RSA – DSA – ECC(C/JAVA Programming). Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography – Quantum Cryptography – Water Marking - DNA Cryptography.

RECOMMENDED TEXTBOOKS:

1. William Stallings,"Cryptography and Network Security", PHI/Pearson Education.
2. Bruce Schneir, "Applied Cryptography", CRC Press.

REFERENCE BOOKS

1. A.Menezes, P Van Oorschot and S.Vanstone, "Hand Book ofApplied Cryptography", CRC Press, 1997
2. AnkitFadia,"NetworkSecurity",MacMillan.

E-LEARNING RESOURCES

1. https://nptel.ac.in/courses/106/105/106105031/
2. http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3. https://www.tutorialspoint.com/cryptography/index.html

GUIDELINES TO THE QUESTION PAPER SETTERS
QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply cryptographic algorithms (AES, RSA, ECC) to secure data and verify correctness.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design secure communication systems using authentication and encryption techniques.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop and analyze network security mechanisms such as firewalls and intrusion detection.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply cybersecurity tools and practices through case studies and audits.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate legal, ethical, and privacy issues and propose secure solutions.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - V**
COURSE NAME: AI in Cloud Computing	**COURSE CODE: 26PCAI326**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To equip students with foundational knowledge of cloud computing and practical skills to deploy, manage, and scale AI models using cloud infrastructure.

COURSE OUTCOMES

1. Apply cloud platforms (AWS, Azure, GCP) to deploy AI/ML models and evaluate performance.
2. Design AI-driven cloud solutions for real-world applications.
3. Develop and manage AI models using CI/CD pipelines, monitoring, and versioning.
4. Apply cloud-based AI tools and services for implementation and deployment.
5. Evaluate ethical and legal challenges in AI-cloud systems and propose responsible strategies.

UNIT I **12 HOURS**

Introduction to Cloud Computing and AI, Cloud Computing Concepts: Cloud service models - IaaS, PaaS, SaaS; Deployment models: Public, Private, Hybrid, Community Cloud; Virtualization and containerization - Cloud providers: AWS, Google Cloud, Microsoft Azure –Integration of AI and Cloud: Cloud infrastructure for AI models - AI offerings for deploying and managing AI models - Benefits of combining AI with Cloud Computing.

UNIT II **12 HOURS**

Cloud Computing Infrastructure for AI, AI Workloads in Cloud: Cloud computing resources for AI: CPU, GPU, TPU - Performance and scalability of AI workloads - Cloud platforms supporting AI: AWS, Google Cloud, Azure AI.

UNIT III **12 HOURS**

Machine Learning Models and AI in Cloud Environments, Machine Learning Concepts: Supervised, Unsupervised, Reinforcement Learning - Deep Learning: Neural Networks, CNNs, RNNs, GANs - Deploying ML Models in Cloud: Cloud-based tools and platforms for ML model deployment (AWS Sage Maker, Google AI, Azure ML) Serverless AI deployment (AWS Lambda, Google Cloud Functions) - AI Model Management: Model tracking, versioning, monitoring, and retraining - CI/CD practices for AI model deployment.

UNIT IV **12 HOURS**

Advanced AI Applications in Cloud Computing, Cloud Resource Management with AI: Intelligent load balancing, provisioning, and auto-scaling - Cost optimization using AI-driven scheduling. AI for Cloud Security: Anomaly detection, intrusion detection, and encryption in cloud environments. AI and IoT in Cloud: Edge computing for AI in IoT devices - Cloud-based AI solutions for IoT platforms (AWS IoT, Google Cloud IoT).

UNIT V **12 HOURS**

Future of AI in Cloud and Ethical Considerations, Emerging Trends in AI and Cloud: Quantum computing for AI enhancement in cloud environments - Federated Learning for decentralized AI training. Ethical Issues in AI: Bias, fairness, transparency, and accountability in AI models - Ethical frameworks for AI deployment. Legal and Regulatory Aspects: Data privacy laws: GDPR, CCPA - Intellectual property and AI liability in cloud environments.

RECOMMENDED TEXTBOOKS:

1. "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron

REFERENCE BOOKS

1. "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig
2. "Cloud Native Infrastructure: Patterns for Scalable Infrastructure and Applications in a Dynamic Environment" by Justin Garrison and Kris Nova
3. "Cloud Computing for Machine Learning and AI" by Adnan Masood
4. "Architecting the Cloud: Design Decisions for Cloud Computing Service Models (SaaS, PaaS, and IaaS)" by Michael J. Kavis

E-LEARNING RESOURCES

1. AWS AI and Machine Learning : https://aws.amazon.com/machine-learning/
2. Google Cloud AI and Machine Learning: https://cloud.google.com/products/ai
3. Microsoft Azure AI: https://azure.microsoft.com/en-us/overview/ai-platform/
4. IBM Cloud for AI: https://www.ibm.com/cloud/ai
5. Cloud Academy - AI in Cloud Computing: https://cloudacademy.com/
6. Cloud Computing and AI Integration – ResearchGate: https://www.researchgate.net/

GUIDELINES TO THE QUESTION PAPER SETTERS

QUESTION PAPER PATTERN

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	1	1
III	2	2	1
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TOTAL	10	7	5

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply cloud platforms (AWS, Azure, GCP) to deploy AI/ML models and evaluate performance.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design AI-driven cloud solutions for real-world applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop and manage AI models using CI/CD pipelines, monitoring, and versioning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply cloud-based AI tools and services for implementation and deployment.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical and legal challenges in AI-cloud systems and propose responsible strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Science	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - V**
COURSE NAME: Robotic Process Automation	**COURSE CODE: 26PCAI327**
SEMESTER: III	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE:

To teach students how to automate business functionalities using Robotic Process Automation and create desktop automation scripts without coding knowledge.

COURSE OUTCOMES:

1. Apply RPA tools to automate business processes and demonstrate workflows.
2. Design automation solutions for real-world processes using functional bots.
3. Develop RPA solutions using workflows, data manipulation, and UI automation.
4. Apply RPA tools and deployment practices for bot development and management.
5. Evaluate risks, challenges, and ethical concerns and propose automation strategies.

UNIT I **12 HOURS**

Introduction to Robotic Process Automation: History of automation, Robotic Process Automation (RPA) concepts, RPA versus traditional automation, Processes and flowcharts, Programming constructs in RPA, Types of bots, Processes suitable for automation, Benefits and challenges of RPA, RPA lifecycle, RPA development methodology, Process Design Document (PDD), Business applications of RPA.

UNIT II **12 HOURS**

RPA Tools and Workflow Design: Introduction to RPA tools, User interface and project organization, Variables and data types, Sequences and workflows, Activities, Flowcharts and workflow design, Control flow activities – Assign, Delay, Break, While, Do While, For Each, If and Switch, Debugging basics.

UNIT III **12 HOURS**

Data Manipulation and UI Automation: Variables and scope, Collections and arguments, Data tables and data scraping, Clipboard management, File operations, Excel and CSV automation, UI automation concepts, Finding and interacting with controls, Mouse and keyboard activities, UI Explorer, Event handling.

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UNIT IV **12 HOURS**

Advanced Automation Techniques: Recording, Screen scraping, Data scraping, OCR concepts and applications, Selectors, Image and text automation, PDF automation, Anchors, Credential management, Web automation, Plugins and extensions.

UNIT V **12 HOURS**

Automation Deployment and Management: Email automation, Database connectivity and queries, Exception handling, Triggers, Testing and debugging, Publishing bots, Introduction to Orchestrator/Control Room concepts, Bot deployment and monitoring, Package management, Maintenance of automation solutions.

RECOMMENDED TEXTBOOKS:

1. Alok Mani Tripathi, Learning Robotic Process Automation, 2nd Edition, Packt Publishing, 2020.
2. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Apress, 2020.

REFERENCE BOOKS

1. Srikanth Merianda, Robotic Process Automation Projects, Packt Publishing, 2019.
2. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, BPB Publications, 2021.
3. Mary C. Lacity and Leslie P. Willcocks, Robotic Process and Cognitive Automation: The Next Phase, SB Publishing, 2018.
4. Will Van Der Aalst, Robotic Process Automation, Springer, 2018.

E-LEARNING RESOURCES

1. UiPath Academy
2. UiPath Documentation
3. Automation Anywhere University
4. Microsoft Power Automate Learning Path
5. Blue Prism Learning Resources

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
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C	*Answer any 3 out of 5 questions(each in 1200 words*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Apply RPA tools to automate business processes and demonstrate workflows.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design automation solutions for real-world processes using functional bots.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop RPA solutions using workflows, data manipulation, and UI automation.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply RPA tools and deployment practices for bot development and management.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate risks, challenges, and ethical concerns and propose automation strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS - III**
COURSE NAME: Open Source AI Tools Sustainability	**COURSE CODE: 26PGSL407**
SEMESTER: IV	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS: 30**
PRACTICAL	

COURSE OBJECTIVE

To develop practical skills in using AI tools for research, content creation, programming, and task automation.

COURSE OUTCOMES

1. Apply AI tools for content generation and information retrieval.
2. Implement AI tools for research and documentation tasks.
3. Create digital content using AI-powered applications.
4. Develop software solutions with the assistance of AI coding tools.
5. Evaluate AI tools for automation and productivity enhancement.

UNIT I **6 HOURS**

Introduction to AI Tools

1. Generate and refine text content using AI prompts.
2. Perform text summarization and language translation using AI tools.
3. Compare outputs generated using different prompting techniques.

UNIT II **6 HOURS**

AI Tools for Research and Documentation

1. Conduct AI-assisted information retrieval on a given topic.
2. Generate a literature review and structured notes from research articles.
3. Prepare a technical report using AI-assisted documentation tools.

UNIT III **6 HOURS**

AI Tools for Content Creation

1. Create articles, blogs, or reports using AI content generation tools.
2. Generate images from textual descriptions using AI image-generation tools.
3. Develop presentation slides using AI-assisted presentation tools.

UNIT IV **6 HOURS**

AI Tools for Programming and Development

1. Generate source code for simple applications using AI coding assistants.

2. Debug and optimize existing programs using AI tools.
3. Create code documentation and test cases using AI assistance.

UNIT V **6 HOURS**

Advanced AI Tools and Automation

1. Perform image and document analysis using multimodal AI tools.
2. Automate repetitive tasks using AI-powered workflow tools.
3. Evaluate and compare the performance of multiple AI platforms for a given problem.

Question Paper pattern : MCQ

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: B	**COURSE COMPONENT: - Self Study**
COURSE NAME: MOOC/ NPTEL Course	**COURSE CODE: 26PSSP401**
SEMESTER: III	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS:**
THEORY	

MOOC Course:

Students must complete and obtain certification in one NPTEL / SWAYAM-MOOC course of their choice before the end of fourth semester. The course will carry 2 credits and is a mandatory requirement for the award of the degree. On successful completion of the course, the candidate has to submit the copy of the certificate to the Head of the Department. The Head of the Department can form a team of faculty members to recommend the grade to be awarded to the candidate by mapping the score earned by the students and the results can be sent to the Controller of Examinations after the approval of the Head of the Department.

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: B	**COURSE COMPONENT: INTERNSHIP**
COURSE NAME: Internship	**COURSE CODE: 26PINT401**
SEMESTER: III	**MARKS:**
CREDITS: 2	**TOTAL HOURS:**
INTERNSHIP	

COURSE OBJECTIVES

To make students aware of practices that are followed in the corporate environment

COURSE OUTCOMES

1. Apply academic knowledge to real-world IT problems.
2. Develop domain knowledge, multidisciplinary, and professional skills.
3. Gain industry exposure through practical experience.
4. Practice ethical and sustainable computing approaches.
5. Enhance employability skills.

Internship Program:

- Internships must be supervised, structured learning experiences in a professional setting, that allow you to gain valuable work experience in a chosen field of study.
- Internships must be under the Direct supervision of a professional(s) with relevant expertise and educational and/or professional experience who can provide productive feedback, guidance, and the resources and equipment necessary to complete the internship.
- During the summer vacation of the First year, each student should undergo training in software or software-related registered organization for 25 working days (typically, at least 10 hours per week during summer).
- Every student must present their learning experience as a report soon after the college is reopened.

SEMESTER IV

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: CORE - XV**
COURSE NAME: Project with Viva Voce	**COURSE CODE: 26PCAI321**
SEMESTER: IV	**MARKS: 100**
CREDITS: 13	**TOTAL HOURS:**
MAJOR PROJECT	

COURSE OBJECTIVE:

To enable students to develop a unique project by defining the problem, designing and implementing it using available software development tools/programming, and preparing a report.

COURSE OUTCOMES:

1. Apply domain-specific theories, principles, and methodologies to design and execute meaningful projects.
2. Identify complex problems and develop innovative, practical, and multidisciplinary solutions.
3. Demonstrate the ability to conduct research, analyse data, and interpret findings to support informed decision-making.
4. Integrate ethical practices, sustainability, and social responsibility into project work, contributing positively to society.
5. Present and document project outcomes, while cultivating adaptability and continuous learning.

MAJOR PROJECT GUIDELINES:

Mode of Major Project: Individual Project

Nature of Major Project: Every student must choose a unique project title (novel concept, idea,system, or a small research problem) approved by their guide and then design and implement it using available software development tools or programming languages.

Guide: Each Student shall be allotted under the Guidance of one **Department faculty member by the Head of the Department.**

Continuous Assessment: Based on periodic reviews (Three reviews during the Semester. Tentative review dates are decided by the department and to be intimated to the students at the beginning of the fourth Semester)

Evaluation criteria

Each student is evaluated by the Internal Examiner (Guide) continuously during the respective semester. External Examination will be conducted at the end of the respective semester.

Passing Criteria

Student shall secure a minimum of **50 % marks in the external** evaluation and shall secure a **minimum of 50 % marks in combined Internal and External evaluation**. (There is no passing minimum for the internal evaluation)

<table>
<tr><td colspan="2">Internal (50 Marks)</td><td colspan="2">External (50 Marks)</td></tr>
<tr><td>Review I

(Problem identification, Title & Abstract submission, The novelty of the idea proposed outcomes, issues in existing methods, tools to be used</td><td>15 Marks</td><td colspan="2">Both Internal and External Examiner Shall evaluate the student based on the following criteria at the end of the semester:

(Guide or any other department faculty decided by the HOD shall be the Internal Examiner. External Examiner will be appointed by the COE)</td></tr>
<tr><td>Review II

System Design / Database Design /Methodology/ Algorithms and Techniques / detailed Implementation plan</td><td>15 Marks</td><td>Internal Examiner

Project Report</td><td>20 Marks</td></tr>
<tr><td>Review III

System Implementation status, Testing, outcomes and report writing</td><td>20 Marks</td><td>External Examiner shall evaluate under the following criteria
● Presentation of the Project
● Demonstration of the working project
● Viva -voce</td><td>10 Marks
10 Marks
10 Marks</td></tr>
<tr><td>Total</td><td>50 Marks</td><td></td><td>50 Marks</td></tr>
</table>

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	2	2	2	3	3
CO 5	2	3	3	2	3
Ave.	**2.6**	**2.8**	**2.8**	**2.8**	**2.8**

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	2	2	2
CO 5	2	3	3
Ave.	**2.6**	**2.8**	**2.8**

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - VI**
COURSE NAME: Artificial Intelligence Ethics	**COURSE CODE: 26PCAI320**
SEMESTER: IV	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To gain knowledge in building ethical machines, understand ethical issues in AI algorithms, analyze current AI policies, and apply ethical principles in AI applications.

COURSE OUTCOMES:

1. Analyze AI systems using ethical frameworks to determine societal impact.
2. Design AI solutions integrating ethical principles for real-world challenges.
3. Develop ethical AI models ensuring fairness, accountability, and transparency.
4. Evaluate professional practices in AI ethics through policy and scenario analysis.
5. Recommend governance strategies by analyzing legal, ethical, and societal implications

UNIT I **I2 HOURS**

Introduction to AI Ethics: Foundations of ethics, Ethical theories and decision making, Ethics in artificial intelligence, Ethical challenges in AI systems, Human values and AI, Moral agency and machine ethics, Ethical implications of autonomous systems, Responsible AI principles.

UNIT II **12 HOURS**

Ethics of Data and Intelligent Systems: Data collection and ownership, Privacy and consent, Data protection and security, Algorithmic decision making, Ethical issues in machine learning systems, Ethics of information and intelligent agents, Ethical concerns in web-based AI applications, Transparency and accountability.

UNIT III **12 HOURS**

Fairness, Explainability and Trustworthy AI: Bias and discrimination in AI systems, Fairness and inclusiveness, Explainable AI (XAI), Interpretability and transparency, Trustworthy AI principles, Human-AI interaction, Ethical design and deployment of AI systems, Challenges in implementing ethical AI.

UNIT IV **12 HOURS**

AI Governance, Safety and Public Policy: AI governance frameworks, National and international AI regulations, AI safety and risk management, Economic and social impact of AI, AI and employment, AI in public services, AI and national security, Ethical considerations in emerging AI technologies.

UNIT V **12 HOURS**

Applications and Case Studies in AI Ethics: Ethics in healthcare AI, Ethics of autonomous vehicles, Ethics in predictive policing and criminal justice, AI in finance and business, Generative AI and creative systems, Autonomous weapons and military AI, Case studies on responsible AI implementation.

RECOMMENDED TEXTBOOKS:

1. Mark Coeckelbergh, AI Ethics, MIT Press, 2020.
2. Matthew Liao (Ed.), Ethics of Artificial Intelligence, Oxford University Press, 2020.

REFERENCE BOOKS

1. Etzioni A (2017), Incorporating ethics inti Artificial Intelligence, Journal of Ethics
2. Hooker, J., & Hooker, J. (2018). Ethics of Artificial Intelligence. In Taking Ethics Seriously

E-LEARNING RESOURCES

1. Bauer, W. A. (2020). Virtuous vs. utilitarian artificial moral agents. AI and Society. https://doi.org/10.1007/s00146-018-0871-3

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

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CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze AI systems using ethical frameworks to determine societal impact.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design AI solutions integrating ethical principles for real-world challenges.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Develop ethical AI models ensuring fairness, accountability, and transparency.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Evaluate professional practices in AI ethics through policy and scenario analysis.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Recommend governance strategies by analyzing legal, ethical, and societal implications	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
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Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE - VI**
COURSE NAME: IT Cognition	**COURSE CODE: 26PCAI328**
SEMESTER: IV	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To gain insights into cognitive systems, apply cognitive techniques to problem-solving, integrate computer science principles in designing cognitive systems, and evaluate their performance.

COURSE OUTCOMES

1. Analyze human-computer interaction scenarios using cognitive principles to identify performance factors.
2. Develop system designs incorporating cognitive models to enhance usability.
3. Integrate cognitive theories to generate problem-solving and reasoning strategies.
4. Apply cognitive competencies such as critical thinking and adaptive reasoning.
5. Justify responsible usage strategies by analyzing ethical issues in cognitive technologies

UNIT I **12 HOURS**

Introduction to Cognition: Meaning cognitive processes, Development of cognitive psychology: Structuralism, Functionalism, Behaviorism, Memory Research, Gestalt psychology, Emergenc of cognitive psychology, Information Processing, Connectionism, Alternate approaches to cognitive psychology, Research Methods in Cognitive Psychology.

UNIT II **12 HOURS**

Perceptual Processes: Object Recognition- theories of object recognition, Bottom- Up and Top-Down Processing, Face Perception, Change Blindness. Attention: Divided attention, Selective: Varieties, Subliminal Perception. Visual Perception-Perceptual Organizational -Processes, Multisensory interaction and Integration – Synthesis, Comparing the senses, Perception and Action.

UNIT III **12 HOURS**

Memory- Working Memory: Research on Working Memory, Factors affecting the capacity of working Memory, Baddeley's Working Memory Approach. Long Term Memory: Encoding and Retrieval in Long Term Memory, Autobiographical Memory. Memory Strategies: Practice, Mnemonics using Imagery, Mnemonics using organization, The Multimodal Approach, Improving Prospective Memory. Meta cognition: Meta memory, TOT, Meta comprehension.

UNIT IV **12 HOURS**

Problem Solving, Reasoning and Decision Making:VUCA World Problem Solving–Types of problem, Understanding the problem, Problem-Solving Approaches, Factors that influence Problem Solving, creativity, Reasoning – Inductive and Deductive Reasoning Decision Making – Heuristics in decision making – representativeness, availability and anchoring and adjustment. The Framing effect, Overconfidence in decisions, The Hindsight Bias.

UNIT V **12 HOURS**

Future Skills: Critical thinking, Adaptive thinking, Cognitive Load Management, Design thinking, Virtual Collaboration and Cultural Sensitivity.

RECOMMENDED TEXTBOOKS

1. Matlin M.W. (2003) 'Cognition' 5th Edition, Wiley Publication
2. Riegler, B.R., Reigler, G.L. (2008), Cognitive Psychology – Applying the Science of Mind. 2nd Edition, Pearson Education.

REFERENCE BOOKS

1. Benjafield J G (2007). 'Cognition' 3rd Edition. Oxford University Press
2. Goldstein B.E.(2008) 'Cognitive Psychology' 2nd Edition, Wadsworth.

E-LEARNING RESOURCES

1. https://www.engati.com/glossary/cognitive-science
2. https://www.psychologicalscience.org/observer/cognition-and-perception-is-there-really-a-distinction
3. https://pubmed.ncbi.nlm.nih.gov/9496622/

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

SECTION	QUESTION COMPONENT	NUMBERS	MARKS	TOTAL
A	*Answer all the questions*	*1-10*	*2*	*20*
B	*Answer any 5 out of 7 questions*	*11-17*	*7*	*35*
C	*Answer any 3 out of 5 questions(each in 1200 words)*	*18-22*	*15*	*45*
TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5
	SECTION A - 10	**SECTION B – 7**	**SECTION C - 5**

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3
Ave.	3	3	3	3	3

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	3	3	3
CO 5	3	3	3
Ave.	3	3	3

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Analyze human-computer interaction scenarios using cognitive principles to identify performance factors.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Develop system designs incorporating cognitive models to enhance usability.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Integrate cognitive theories to generate problem-solving and reasoning strategies.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Apply cognitive competencies such as critical thinking and adaptive reasoning.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Justify responsible usage strategies by analyzing ethical issues in cognitive technologies	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
Mid-Semester Examination	Pen and Paper test for 90 minutes	50	10
Model Examination	Written examination for 180 minutes	100	10
Assignment	Any topic related to the course	5	5
Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: A	**COURSE COMPONENT: ELECTIVE- VI**
COURSE NAME: Agile Software Engineering	**COURSE CODE: 26PCAI329**
SEMESTER: IV	**MARKS: 100**
CREDITS: 3	**TOTAL HOURS: 60**
THEORY	

COURSE OBJECTIVE

To provide a comprehensive understanding of Agile methodologies, comparing them with traditional models, and equipping students with the skills to establish, mentor, and apply Agile principles and practices for effective software development.

COURSE OUTCOMES:

1. Develop Agile methodologies (Scrum, XP, Kanban) using appropriate tools to manage software development.
2. Design software solutions through iterative Agile development for real-world applications.
3. Apply advanced Agile techniques such as refactoring, CI/CD, and test-driven development to improve software quality.
4. Illustrate teamwork and collaboration skills in managing Agile projects in a professional environment.
5. Evaluate ethical issues in software engineering and propose responsible Agile practices addressing quality and stakeholder concerns.

UNIT I **12 HOURS**

Fundamentals of Agile Process: Introduction and background, Agile Manifesto and Principles, Stakeholders and Challenges, Overview of Agile Development Models: Scrum, Extreme Programming, Feature Driven Development, Crystal, Kanban, and Lean Software Development.

UNIT II **12 HOURS**

Agile Projects: Planning for Agile Teams: Scrum Teams, XP Teams, General Agile Teams, Team Distribution; Agile Project Lifecycles: Typical Agile Project Lifecycles, Phase Activities, Product Vision, Release Planning: Creating the Product Backlog, User Stories, Prioritizing and Estimating, Creating the Release Plan; Monitoring and Adapting: Managing Risks and Issues, Retrospectives.

UNIT III **12 HOURS**

Introduction to Scrum: Agile Scrum Framework, Scrum Artifacts, Meetings, Activities and Roles, Scrum Team Simulation, Scrum Planning Principles, Product and Release Planning, Sprinting: Planning, Execution, Review and Retrospective; User story definition and Characteristics, Acceptance tests and Verifying stories, Burn down chart, Daily scrum, Scrum Case Study.

UNIT IV **12 HOURS**

Introduction to Extreme Programming (XP): XP Lifecycle, The XP Team, XP Concepts: Refactoring, Technical Debt, Timeboxing, Stories, Velocity; Adopting XP: Pre-requisites, Challenges; Applying XP: Thinking- Pair Programming, Collaborating, Release, Planning, Development; XP Case Study.

UNIT V **12 HOURS**

Agile Software Design and Development: Agile design practices, Role of design Principles, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control; Agility and Quality Assurance: Agile Interaction Design, Agile approach to Quality Assurance, Test Driven Development, Pair programming: Issues and Challenges.

RECOMMENDED TEXTBOOKS:

1. Robert C. Martin, Agile Software Development- Principles, Patterns and Practices, Prentice Hall, 2013.
2. Kenneth S. Rubin, Essential Scrum: A Practical Guide to the Most Popular Agile Process, Addison Wesley, 2012.

REFERENCE BOOKS:

1. James Shore and Shane Warden, The Art of Agile Development, O'Reilly Media, 2007.
2. Craig Larman, ―Agile and Iterative Development: A manager's Guide, Addison-Wesley, 2004.
3. Ken Schawber, Mike Beedle, Agile Software Development with Scrum, Pearson, 2001.
4. Cohn, Mike, Agile Estimating and Planning, Pearson Education, 2006.
5. Cohn, Mike, User Stories Applied: For Agile Software Development Addison Wisley, 2004.

GUIDELINES TO THE QUESTION PAPER SETTERS QUESTION PAPER PATTERN

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TOTAL MARKS				**100**

BREAK UP OF QUESTIONS

UNITS	SECTION A	SECTION B	SECTION C
I	2	2	1
II	2	2	1
III	2	1	1
IV	2	1	1
V	2	1	1
TOTAL	10	7	5

PO – CO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO5
CO 1	3	3	3	3	2
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	2	2	2	3	3
CO 5	2	3	3	2	3
Ave.	2.6	2.8	2.8	2.8	2.8

PSO – CO MAPPING

	PSO 1	PSO 2	PSO 3
CO 1	3	3	3
CO 2	3	3	3
CO 3	3	3	3
CO 4	2	2	3
CO 5	2	3	2
Ave.	2.6	2.8	2.8

PO – PSO – CO QUESTION PAPER MAPPING

CO No.	COURSE OUTCOMES	POs ADDRESSED	PSOs ADDRESSED	COGNITIVE LEVEL (K1 to K6)
CO1	Develop Agile methodologies (Scrum, XP, Kanban) using appropriate tools to manage software development.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO2	Design software solutions through iterative Agile development for real-world applications.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO3	Apply advanced Agile techniques such as refactoring, CI/CD, and test-driven development to improve software quality.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO4	Illustrate teamwork and collaboration skills in managing Agile projects in a professional environment.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6
CO5	Evaluate ethical issues in software engineering and propose responsible Agile practices addressing quality and stakeholder concerns.	PO1 TO PO5	PSO1 TO PSO3	K1 TO K6

K1= Remember, K2= Understand, K3= Apply, K4=Analyse, K5= Evaluate, K6= Create

Continuous Internal Assessment - Components			
Assessment Type	**Nature**	**Maximum Marks**	**Weightage**
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Workbook/recordbook/ notebook	Handwritten Class Notes	5	5
Class activity 1	Seminar/ Presentation	5	5
Class activity 2	Group Discussion	5	5
Class activity 3	Quiz with MCQ	5	5
Attendance	Marks will be given based on the attendance percentage of respective course		5
Total			50

PROGRAMME: M.Sc. Computer Science with Artificial Intelligence	**BATCH: 2026 - 28**
PART: B	**COURSE COMPONENT: ABILITY ENHANCEMENT SKILLS - IV**
COURSE NAME: Role of AI for Environmental Sustainability	**COURSE CODE: 26PGSL410**
SEMESTER: IV	**MARKS: 100**
CREDITS: 2	**TOTAL HOURS: 30**
THEORY	

COURSE OBJECTIVE

To explore the applications of AI in promoting environmental sustainability, focusing on areas like climate change mitigation, resource management, sustainable agriculture, and pollution control.

UNIT I **6 HOURS**

Introduction to AI and Environmental Sustainability: Overview of Artificial Intelligence, Role of AI in sustainability, Environmental challenges and sustainable development, Climate change and environmental impacts, Energy consumption and sustainable practices, AI for natural resource management.

UNIT II **6 HOURS**

AI for Climate Change and Energy Management: AI for climate prediction and weather forecasting, Climate change impact assessment, Renewable energy optimization, Smart energy management, Carbon emission monitoring and reduction, AI-based climate adaptation strategies.

UNIT III **6 HOURS**

AI for Biodiversity Conservation and Ecosystem Management: AI in wildlife monitoring - species protection - habitat restoration - detecting poaching - AI for ecosystem health - machine learning in conservation efforts.

UNIT IV **6 HOURS**

AI in Sustainable Agriculture and Water Management: Precision agriculture, Crop monitoring and yield prediction, Resource-efficient irrigation, Soil health monitoring, Pest and disease detection, AI for water resource management and sustainable farming practices.

UNIT V **6 HOURS**

AI in Waste Management and Pollution Control: AI for waste sorting and recycling automation, Pollution monitoring and control, Air and water quality analysis, Smart waste management systems, AI for reducing environmental pollution, Case studies on AI applications for environmental sustainability.

RECOMMENDED TEXTBOOKS:

1. Mohit Kumar and Amandeep Kaur, *Artificial Intelligence for Environmental Sustainability*, CRC Press, 2024.
2. Ahmed Banafa, *Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies*, River Publishers, 2024.

REFERENCE BOOKS

1. Adedeji B. Badiru and Vhance V. Valencia, *Artificial Intelligence and Machine Learning Applications in Environmental Sustainability*, CRC Press, 2021.
2. Tsau Young Lin and Sabu M. Thampi (Eds.), *Artificial Intelligence for Climate Change Adaptation and Mitigation, Springer*, 2022.
3. Erik Garcell, *Artificial Intelligence in Agriculture and Environmental Science,* Springer, 2023.
4.

E-LEARNING RESOURCES

1. UN Environment Programme (UNEP)
2. AI for Earth by Microsoft
3. Google Sustainability Resources
4. United Nations Sustainable Development Goals Platform
5. AI for Everyone (Coursera)

Question Paper pattern : MCQ