GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Computer Applications

Level: Post Graduate

Course / Subject Code: MC03094051

Course / Subject Name: Artificial Intelligence

w. e. f. Academic Year:	2025-26
Semester:	3
Category of the Course:	Elective Group-1

Prerequisite:	Basic programming concepts, data structures, discrete mathematics, fundamentals of algorithms and complexity, probability theory
Rationale:	This course provides foundational knowledge in artificial intelligence. It is focusing on logical reasoning, problem-solving techniques, and uncertainty modeling essential for designing intelligent systems. The course equips students with practical skills in logic programming using PROLOG, heuristic search methods, and probabilistic reasoning, enabling them to develop effective AI solutions for real-world problems.

Course Outcome:

After Completion of the Course, Student will able to:

No.	Course Outcomes	RBT Level*
1	Apply formal logic systems to represent and reason with knowledge.	AP
2	Analyse the inherent limitations of classical logic in AI	AN
3	Develop logic program using PROLOG	AP
4	Implement search strategies and game-playing algorithms for effective problem-solving in AI	AP
5	Apply probabilistic reasoning and Bayesian networks to handle uncertainty	AP

*RM: Remember, UN: Understand, AP: Apply, AN: Analyze, EL: Evaluate, CR: Create

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	Weightage (%)
1	**Introduction and Logics:** Basics of artificial intelligence, the history of AI, agents, knowledge-based systems. Propositional Logic: Syntax, Semantics, Proof Systems, Resolution, Horn Clauses, Computability and Complexity, Applications and Limitations First-order Predicate Logic: Logic Syntax, Semantics, Quantifiers and Normal Forms, Basic Examples of First-order Logic Statements	11	25
2	**Limitations of Logic:** The Search Space Problem, Decidability and Incompleteness, The Flying Penguin, Modeling Uncertainty	5	10
3	**Logic Programming with PROLOG:** PROLOG Systems and Implementations, Simple Examples, Execution Control and Procedural Elements, Lists, Self-modifying Programs, A Planning Example, Constraint Logic Programming	5	10
4	**Search, Games and Problem Solving:** Introduction, Uninformed Search, Breadth-First Search, Depth-First Search, Iterative Deepening, Comparison, Cycle Check, Heuristic Search, Greedy Search, A★-Search, Route Planning with the A★ Search Algorithm, IDA★-Search, Empirical Comparison of the Search Algorithms, Summary, Games with Opponents, Minimax Search, Alpha-Beta-Pruning, Non-deterministic Games, Heuristic Evaluation Functions, Learning of Heuristics, State of the Art.	12	30
5	**Reasoning with Uncertainty:** Reasoning with Uncertainty, Computing with Probabilities, Conditional Probability, The Principle of Maximum Entropy, An Inference Rule for Probabilities, Maximum Entropy Without Explicit Constraints, Conditional Probability Versus Material Implication, MaxEnt-Systems, The Tweety Example, Reasoning with Bayesian Networks, Independent Variables, Graphical Representation of Knowledge as a Bayesian Network, Conditional Independence, Practical Application, Software for Bayesian Networks, Development of Bayesian Networks	12	25
	Total Hours:	**45**	**100%**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	30	45	15	0	0

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

Textbook:

1. Introduction to Artificial Intelligence, By: Wolfgang Ertel, 2nd Edition, Springer

References Books:

1. Artificial Intelligence A Modern Approach, By: Stuart Russell and Peter Norving, 3rd Edition, Pearson Publication
2. First Course In Artificial Intelligence, By Deepak Khemani, Mc Graw Hill
3. Artificial Intelligence, By Elaine Rich and Kevin Knight, 2nd Edition, Mc Graw Hill
4. Artificial Intelligence: Making a System Intelligent, By: Dr. Nilakshi Jain, As per AICTE, Wiley Publication
5. Introduction to Artificial Intelligence, By: Eugene Charniak and Drew McDermott, Addison-Wesley Series in Computer Science
6. Artificial Intelligence: An Engineering Approach, By: Robert J. Schalkoff, Mc Graw Hill,
7. Programming in Prolog: Using the ISO Standard, By: William F. Clocksin, Christopher S. Mellish, 5th Edition, Springer

List of Useful websites / MOOCs

1. Learners are advised to opt for NPTEL and SWAYAM courses that are relevant to this course

Suggested Course Practical List:

To perform followings Lab work:

S/W Required: GNU Prolog, SWI-Prolog, MATLAB, Python, Code block C/C++

1. Define family relationships (parent, child, sibling, grandparent) using facts and rules.
2. Identify all ancestors of a person using recursive rules.
3. Create a knowledge base of animals and classify them as birds, mammals, etc., and query their properties.
4. Implement a simple expert system to identify diseases based on symptoms.
5. Define arithmetic operations using recursive logic (e.g., addition, factorial).

6. Represent and solve a basic logic puzzle (e.g., who owns the zebra?).
7. Create a list-based program to find the maximum of a list.
8. Use lists to reverse elements and query the reversed list.
9. Implement a simple database of books and authors and query based on genre or author.
10. Model and reason about traffic lights (e.g., when is it safe to cross?).
11. Represent family tree data and infer cousin or uncle relationships.
12. Define a rule-based planning system to plan a simple sequence of tasks (e.g., preparing tea).
13. Simulate an AI agent's decision-making using facts and rules.
14. Model a simple library management system and allow checking book availability.
15. Create a timetable conflict checker for classrooms using constraints.
16. Use lists and recursion to calculate the length of a list.
17. Model a set of rules for granting university admission based on criteria.
18. Represent propositional logic formulae and test satisfiability (manually).
19. Simulate a basic flight route planner using simple search rules.
20. Define and simulate the game of Tic-Tac-Toe with basic moves.
21. Write a knowledge base for different animals and identify which can fly (Flying Penguin example).
22. Define and implement rules for sorting a list of numbers using recursion.
23. Represent and evaluate first-order logic statements (e.g., all humans are mortal, Socrates is a human).
24. Simulate a basic constraint logic programming example like Sudoku (3x3).
25. Model a simple chatbot using pattern matching and rules for basic conversation.
26. Implement Breadth-First Search to find a path between two cities in a connected graph.
27. Model a maze and solve it using Depth-First Search in PROLOG.
28. Simulate a simple two-player game (e.g., Nim game) with Minimax strategy.
29. Develop an A search algorithm for finding the shortest route between locations with given heuristics.

City	Heuristic (h) to Goal
A	10
B	6
C	4
D	7
E	2
Goal	0

30. Implement Alpha-Beta Pruning in a simple game tree (like a reduced Tic-Tac-Toe tree).
31. Simulate uncertain knowledge by assigning confidence levels to rules and use rule selection based on thresholds.
32. Model the Tweety example using exceptions and rules to handle uncertainty (e.g., birds generally fly unless they are penguins).

33. Implement a rule-based system where multiple causes can lead to a symptom, and the program ranks possible causes.
34. Design a simplified Bayesian-like reasoning system using rule weights or scoring system (simulated in PROLOG).
35. Build a basic expert system for weather prediction using rule-based inference with uncertain facts (e.g., "if clouds and humidity are high, rain is likely").

CO- PO Mapping:

Semester : 3	**Course Name : Artificial Intelligence**							
	POs							
Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
CO1	3	2	2	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-
CO3	2	1	3	3	-	-	-	-
CO4	3	3	3	2	-	-	-	-
CO5	3	2	2	2	-	-	-	-

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

Note: The CO-PO mapping is indicative; the institute/faculty member can change as required.

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