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|-----------------------|--------------------------------|
| <b>COURSE TITLE</b>   | <b>ARTIFICIAL INTELLIGENCE</b> |
| <b>COURSE CODE</b>    | <b>01AI0511</b>                |
| <b>COURSE CREDITS</b> | <b>4</b>                       |

**Objective:**

- Objective of this course is to provide students with the fundamental concepts, models and techniques used to design intelligent systems for real-world problem solving and to enable students to formulate AI problems, apply search, reasoning, planning and learning methods, and build responsible AI solutions using modern tools and datasets.

**Course Outcomes:** After completion of this course, student will be able to:

- Understand the foundations of artificial intelligence, intelligent agents and problem characteristics
- Apply search, game playing, knowledge representation and reasoning techniques to solve structured AI problems
- Analyze planning, constraint satisfaction and probabilistic reasoning methods for decision making under uncertainty
- Develop small intelligent systems using rule-based, probabilistic and learning-based approaches. (Create) Evaluate real-world AI solutions with respect to performance, ethics, explainability, safety and deployment considerations

**Pre-requisite of course:** Basic knowledge of data structures, discrete mathematics, probability and statistics, and Python programming.

**Teaching and Examination Scheme**

| <b>Theory Hours</b> | <b>Tutorial Hours</b> | <b>Practical Hours</b> | <b>ESE</b> | <b>IA</b> | <b>CSE</b> | <b>Viva</b> | <b>Term Work</b> |
|---------------------|-----------------------|------------------------|------------|-----------|------------|-------------|------------------|
| 3                   | 0                     | 2                      | 50         | 30        | 20         | 25          | 25               |

| <b>Contents : Unit</b> | <b>Topics</b>   | <b>Contact Hours</b> |
|------------------------|---|----------------------|
| 1                      | <b>Foundations of Artificial Intelligence and Intelligent Agents</b><br>Introduction to Artificial Intelligence; history and evolution of AI; , characteristics of intelligent behavior; AI applications in healthcare, finance, robotics, manufacturing, education and cybersecurity, intelligent agents and rational agents; PEAS description; types of environments, problem formulation; state-space representation, AI development lifecycle and overview of tools and datasets. | 7                    |
| 2                      | <b>Problem Solving by Search and Adversarial Methods</b><br>Uninformed search: breadth-first, depth-first, depth-limited, iterative deepening and uniform-cost search, informed search: greedy best-first and A*.; heuristic design and admissibility; local search methods, hill climbing and simulated annealing basics; adversarial search; minimax algorithm, alpha-beta pruning; Monte Carlo tree search overview, ; applications in routing, scheduling and game AI             | 8                    |

| <b>Contents : Unit</b> | <b>Topics</b>  | <b>Contact Hours</b> |
|------------------------|--|----------------------|
| 3                      | <b>Knowledge Representation and Automated Reasoning</b><br>Knowledge representation fundamentals, propositional logic and first-order logic basics, syntax, semantics and inference; normal forms; resolution, rule-based systems; forward chaining and backward chaining, semantic networks, frames and ontologies overview, expert systems architecture, knowledge acquisition and explanation facilities.   | 8                    |
| 4                      | <b>Constraint Satisfaction and Planning</b><br>Constraint satisfaction problems; backtracking search, variable and value ordering; forward checking, arc consistency; map coloring, scheduling and Sudoku as CSPs, planning in AI; state-space planning; STRIPS representation basics, goal stack planning; partial-order planning overview, planning applications in robotics, logistics and workflow automation.   | 7                    |
| 5                      | <b>Reasoning Under Uncertainty and Sequential Decision Making</b><br>Probability review for AI; Bayes theorem, probabilistic inference; Bayesian networks, structure, conditional independence and inference basics, hidden Markov models overview; decision networks, utility and rational decision making; Markov decision processes, value iteration and policy concepts, introduction to reinforcement learning and agent-environment interaction                      | 7                    |
| 6                      | <b>Learning in AI, Modern Applications and Responsible AI</b><br>Introduction to learning in AI; nearest neighbor, decision tree, Naive Bayes and perceptron overview, neural networks and representation learning basics, AI for natural language processing, computer vision and recommendation systems, generative AI overview; explainability, fairness, privacy, trust and safety, responsible AI practices; deployment, monitoring and human-in-the-loop AI systems. | 8                    |
| <b>Total Hours</b>     |  | <b>45</b>            |

#### Suggested List of Experiments:

| <b>Contents : Unit</b> | <b>Topics</b>   | <b>Contact Hours</b> |
|------------------------|---|----------------------|
| 1                      | <b>Practical 1</b><br>Set up Python environment for AI and implement a simple reflex or goal-based agent in a toy environment.                                    | 2                    |
| 2                      | <b>Practical 2</b><br>Implement breadth-first search, depth-first search and uniform-cost search on graph or maze problems; compare search cost and path quality. | 2                    |
| 3                      | <b>Practical 3</b><br>Implement A* or heuristic search for 8-puzzle/path planning and evaluate the effect of different heuristics.                                | 2                    |
| 4                      | <b>Practical 4</b><br>Develop a game-playing agent using minimax and alpha-beta pruning for Tic-Tac-Toe or a similar turn-based game.                             | 2                    |

### Suggested List of Experiments:

| Contents :<br>Unit | Topics  | Contact<br>Hours |
|--------------------|---|------------------|
| 5                  | <b>Practical 5</b><br>Build a small rule-based expert system or logic inference engine for a diagnosis or advisory problem.   | 2                |
| 6                  | <b>Practical 6</b><br>Solve a constraint satisfaction problem such as map coloring, Sudoku or N-Queens using backtracking and consistency checking.                                     | 2                |
| 7                  | <b>Practical 7</b><br>Model a simple Bayesian network or probabilistic classifier for prediction or diagnosis and perform inference using a suitable Python library.                    | 2                |
| 8                  | <b>Practical 8</b><br>Develop a mini AI application such as text classification, chatbot prototype or perception demo and report on ethics and explainability considerations.           | 2                |
| 9                  | <b>Practical 9</b><br>Implement a simple planning problem using STRIPS / goal-stack planning for Blocks World, logistics, or robot navigation.  | 2                |
| 10                 | <b>Practical 10</b><br>Implement value iteration or policy-based decision making in a grid-world or similar sequential decision-making environment.                                     | 2                |
| 11                 | <b>Practical 11</b><br>Represent a real-world problem using propositional logic or first-order logic and perform logical inference to derive conclusions using an AI reasoning approach | 2                |
| 12                 | <b>Practical 12</b><br>Implement a simple AI learning model such as k-NN, decision tree, Naive Bayes, or perceptron and compare results on a toy dataset                                | 2                |
| <b>Total Hours</b> |   | <b>24</b>        |

### Textbook :

- 1 Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Pearson, 2010

### References:

- 1 Artificial Intelligence: Foundations of Computational Agents, Artificial Intelligence: Foundations of Computational Agents, David L. Poole and Alan K. Mackworth, Cambridge University Press, 2017
- 2 Artificial Intelligence, Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B. Nair, McGraw-Hill., 2009

### Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery

| <b>Remember / Knowledge</b> | <b>Understand</b> | <b>Apply</b> | <b>Analyze</b> | <b>Evaluate</b> | <b>Higher order Thinking / Creative</b> |
|-----------------------------|-------------------|--------------|----------------|-----------------|---|
| 15.00                       | 20.00             | 20.00        | 20.00          | 10.00           | 15.00                                   |

**Instructional Method:**

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, quiz, brainstorming, MOOCs etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
- 3 Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.
- 4 Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory

**Supplementary Resources:**

- 1 <http://www.nptel.iitm.ac.in/video.php?subjectId=106105077>
- 2 <https://nptel.ac.in/courses/106/102/106102220>
- 3 <https://nptel.ac.in/courses/106/105/106105077/>
- 4 <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-034-artificial-intelligence-fall-2010/>
- 5 Website for search strategy implementation in python <http://code.google.com/p/aima-python/>
- 6 <http://www.journals.elsevier.com/artificial-intelligence/>
- 7 <https://www.technologyreview.com/s/534871/our-fear-of-artificial-intelligence/>
- 8 <http://www.sanfoundry.com/artificial-intelligence-mcqs-inductive-logic-unification-lifting-1/>
- 9 [https://www.tutorialspoint.com/prolog\\_in\\_artificial\\_intelligence/index.asp](https://www.tutorialspoint.com/prolog_in_artificial_intelligence/index.asp)