Course Handout (2022-23 EVEN SEMESTER)

Subject Name/Code : ARTIFICIAL INTELLIGENCE(18CS3T24) Branch/Sem/Batch :

Name of Faculty : REKHA SAHU

Scope & Objective -:

The objective of the course is to provide a strong foundation of fundamental concepts and goals, methods & techniques of Artificial Intelligence (AI) to build intelligent systems with perception, reasoning, and learning abilities

Pre-Requisite -:

Detailed Syllabus:

Module#	CO	Topics	Hours
Module-1	CO1	Artificial Intelligence: Introduction; Intelligent Agents: Agents and Environment, Good Behavior, Nature of Environments, Structure of Agents; Problem Solving: Solving Problems by Searching - Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed search strategies, Searching with Partial Information.	8
Module-2	CO2	Informed Search & Exploration: Informed (Heuristic) search strategies, Heuristic functions, Local Search Algorithms & Optimization Problems; Constraint Satisfaction Problems: Introduction, Backtracking search for CSPs, Local Search for CSPs; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning; Knowledge & Reasoning: Knowledge-Based Agents, TheWumpusWorld.	10
Module-3	CO3	Knowledge and Reasoning: Logic, Propositional Logic, Reasoning Patterns in Propositional Logic; First-Order Logic: Syntax and Semantics of First- Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic; Inference in First-Order Logic: Propositional vs. First-Order Logic, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering , Categories and Objects, Semantic Nets, Frames.	8
Module-4	CO4	Planning: The Planning Problem, Planning with State-Space Search, Partial- Order Planning, Planning Graphs; Uncertain Knowledge & Reasoning: Acting under Uncertainty, Bayes Rule and its use; Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks.	8
Module-5	CO5	Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees; Statistical Learning, Instance Based Learning, Neural Networks; Reinforcement Learning: Passive and Active Reinforcement Learning; Expert Systems: Introduction, Architecture, Representations.	8
		Total	42 Hours

#	Topic	Module	Chapter	Course Coverage	No of Classes
1	M1 : Introduction, Intelligent Agents and Task Environment	Module-1	Ch-1	TRUE	1
2	M1 Task Environment & PEAS Description	Module-1	Ch-1	TRUE	1
3	M1 : Intelligent Agents (Five types of Agents)	Module-1	Ch-1	TRUE	1
4	M1 : Problem Solving by Searching : Uninformed Search Example Problems (Route finding problem, 8-Puzzle, 8-Queen, Missionaries & Cannibals)	Module-1	Ch-1	TRUE	1

5	M1 : Uninformed search strategies (BFS & DFS)	Module-1	Ch-1	TRUE	1
6	M1 : Uninformed search strategies (Uniform Cost Search, DEPTH□LIMITED Search, Iterative Deepening, Bidirectional Search))	Module-1	Ch-1	TRUE	1
7	problem discussion on module 1	Module-1	ch-1, 2, 3	TRUE	1
8	test	Module-1	ch - 1, 2, 3	TRUE	1
9	M2 : Informed Search (Evaluation function F(n), Heuristic function H(n) & G(n), Problem definition [S, s, O, G, h])	Module-2	ch2	TRUE	1
10	M2 : Informed Search (Greedy – Best first search with Route finding example)	Module-2	ch2	TRUE	1
11	M2 : Informed Search (A* Search)	Module-2	CH-4	TRUE	1
12	M2 : Informed Search (A* search example problems)	Module-2	ch 4	TRUE	1
13	M2 : Constraint Satisfaction Problems: (Introduction & Map Coloring problem	Module-2	ch-5	TRUE	1
14	M2 : Constraint Satisfaction Problems: (Backtracking search with Map Coloring problem)	Module-2	ch-5	TRUE	1
15	M2 : Adversarial Search: Game playing (8 Puzzle)	Module-2	ch-6	TRUE	1
16	M2 : Adversarial Search (MINIMAX Algorithm with 2-ply & 3-ply games examples)	Module-2	ch-6	TRUE	1
17	M2 : Adversarial Search (Alpha-Beta Pruning with examples	Module-2	ch-6	TRUE	1
18	M2 - Planning & Knowledge-Based Agents (Introduction & block world problem)	Module-2	ch-7	TRUE	1
19	M2 - Planning & Knowledge-Based Agents (Air Cargo, Spare Tire problems	Module-2	ch-7	TRUE	1
20	M2 - Planning & Knowledge-Based Agents (PoP, Shoes & Socks Problem, Hierarchical Planning-House Construction problem)	Module-2	ch-7	TRUE	1
21	problem discussion	Module-2	ch -4, 5, 6, 7	TRUE	1
22	surprise test	Module-2	ch-2, 7	TRUE	1
23	M3: Knowledge and Reasoning: (Introduction & Wumpus World problem)	Module-3	ch-8	TRUE	1
24	M3: Knowledge and Reasoning: (Propositional Logic, Inference Rules, Conjunctive Normal Form)	Module-3	ch-8	TRUE	1
25	M3: Knowledge and Reasoning: (Propositional Logic example problems)	Module-3	ch - 8	TRUE	1
26	M3: Knowledge and Reasoning: (First-order Predicate Logic & Example problems)	Module-3	ch-8	TRUE	1
27	M3: Knowledge and Reasoning: (Forward Chaining & Backward Chaining with example)	Module-3	ch-8	TRUE	1
28	problems discussions on module 3	Module-3	ch-8	TRUE	1
29	M4 : Uncertain Knowledge & Reasoning : Introduction & approaches	Module-4	ch-9	TRUE	1
30	M4 : Uncertain Knowledge & Reasoning :Probability theory (Axioms of probability, Conditional probabilities with examples)	Module-4	ch-9	TRUE	1
31	M4 : Uncertain Knowledge & Reasoning :Probability theory (Bayes’ Rule/Theorem and it's use)	Module-4	ch-9	TRUE	1
32	M4 : Uncertain Knowledge & Reasoning :Probability theory (Bayesian Network)	Module-4	ch-9	TRUE	1
33	M4 : Uncertain Knowledge & Reasoning: Bayesian networks & Burglar alarm example	Module-4	ch-9	TRUE	1
34	problems discussions on module 4	Module-4	ch-9	TRUE	1
35	Quiz test	Module-4	ch-9	TRUE	1
36	M5: Learning: Introduction, Four elements of learning agent, Paradigms of learning	Module-5	ch-10	TRUE	1
37	M5: Learning: Supervised & Unsupervised Learning	Module-5	ch-10	TRUE	1

38	M5: Learning: Inductive Learning, Classification Rules with Example	Module-5	ch-10	TRUE	1
39	M5: Learning: Classification by Decision Tree Induction	Module-5	ch-10	TRUE	1
40	M5: Learning: Classification by Decision Tree Induction (Attribute Selection Measures, Info. Gain splitting attribute method)	Module-5	ch-10	TRUE	1
41	M5: Learning: Classification by Artificial Neural Network (ANN) & Perceptron	Module-5	ch-10	TRUE	1
42	M5: Learning: AND, OR & XOR gate examples	Module-5	ch-10	TRUE	1
43	M5: Learning: Reinforcement Learning	Module-5	ch-10	TRUE	1
44	problem discussion on module 5	Module-5	ch-10	TRUE	1

Total no. of classes : 44

Text Book

S. Russell and P. Norvig, Artificial Intelligence - A Modern Approach, 3rd Edition, Pearson Education, 2016, ., .
D. W. Patterson, Introduction to Artificial Intelligence & Expert Systems, 1st Edition, Pearson Education, 2015, ., .

Reference Book

E. Rich, K. Knight, and S. B. Nair, Artificial Intelligence, 3rd Edition, McGraw Hill Education, 2009, ., .
M. Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, AddisonWesley, 2, ., .
G. F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, 6th Edition, Pearson Education, 2008, ., .
N. J. Nilson, Principles of Artificial Intelligence, Narosa, 2002, ., .
E. Charniak and D. McDermott, Introduction to Artificial Intelligence, 1st Edition, Addison-Wesley, 1985, ., .

Online Reference Material(s):

1. https://nptel.ac.in/courses/106/102/106102220/: by Prof. Mausam, IIT Delhi
2. https://nptel.ac.in/courses/112/103/112103280/: by Prof. S. M. Hazarika, IIT Guwahati
3. https://nptel.ac.in/courses/106/106/106106140/: by Prof. D. Khemani, IIT Madras
4. https://nptel.ac.in/courses/106/106/106106126/: by Prof. D. Khemani, IIT Madras
5. https://nptel.ac.in/courses/106/105/106105079/: by Prof. P. Dasgupta, IIT Kharagpur

Course Outcome:

CO1	Explore agents, environments, and search goal state using uninformed techniques in a state space
CO2	Apply search techniques for game playing and solving constraint satisfaction problems
CO3	Interpret logic, inference rules for decision making, and represent knowledge using semantic nets & frames.
CO4	Apply planning and reasoning to handle uncertainty in real life problems
CO5	Use learning to solve complex real-life problems and design expert systems

Program Outcomes Relevent to the Course:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Mapping of CO's to PO's: (1: Low, 2: Medium, 3: High)

	PO1	**PO2**	**PO3**	**PO4**	**PO6**	**PO12**
CO1	3	3	3	3		1
CO2	2	3	2	3		1
CO3	3	2	2	3		1
CO4	3	2	2	2	1	1
CO5	2	2	2	2	2	1