FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS

- **Sem.** : 1
- **Subject Code** : 05MC0110
- **Subject** : **Artificial Intelligence**

- **Course Objectives** :

- To introduce fundamental concepts, history, and branches of Artificial Intelligence.
- To understand intelligent agents, search algorithms, and problem-solving techniques.
- To explore knowledge representation, reasoning, planning, and uncertainty handling.
- To study neural networks and their role in modern AI systems
- To understand multi-agent systems, robotics, generative AI, and ethical considerations in AI

- **Prerequisites**:

- Basic knowledge of Programming (Python preferred)
- Basic Mathematics (Probability, Logic, Linear Algebra basics)
- Understanding of Data Structures and Algorithms

Unit No	Topics Covered	No of lectures required

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1	**Introduction to AI & Intelligent Agents** **Overview of Artificial Intelligence** Definition, Goals and Scope of AI , History and Milestones: Turing Test, Dartmouth Conference, AI Winters, Branches of AI: Narrow AI, General AI, Super AI , AI vs Machine Learning vs Deep Learning (conceptual distinction only) **Intelligent Agents** Definition of Agent, Environment, and Percept Sequence , PEAS Framework (Performance, Environment, Actuators, Sensors) , Types of Agents , Properties of Environments: Observable, Deterministic, Episodic, Static, Discrete **Introduction to Agentic AI** Definition of Agentic AI: AI systems that autonomously plan, decide, and act to achieve goals , Difference between Traditional AI Agents and Agentic AI Systems , Key Characteristics: Autonomy, Goal-Directed Behavior, Tool Use, Memory **Problem Formulation** Defining Problems, Well-Defined vs Ill-Defined Problems , Toy Problems: 8-Puzzle, N-Queens, Missionaries & Cannibals	**8**

2	**Search Algorithms & Game Playing** **State Space Representation** State Space Graph and Search Tree , Nodes, Edges, Path, Solution, and Optimal Solution , Measuring Problem-Solving Performance: Completeness, Optimality, Time & Space Complexity **Uninformed Search Strategies** Breadth-First Search (BFS) , Depth-First Search (DFS) , Depth-Limited Search , Iterative Deepening DFS (IDDFS) , Bidirectional Search , Uniform Cost Search **Informed (Heuristic) Search Strategies** Greedy Best-First Search , A* Search Algorithm , Heuristic Functions, Admissibility, and Consistency , Memory-Bounded Heuristic Search: IDA* **Local Search & Optimization** Hill Climbing: Simple, Steepest-Ascent, Stochastic , Simulated Annealing , Genetic Algorithms: Crossover, Mutation, Selection , Beam Search , Tabu Search **Adversarial Search & Game Playing** Games as Search Problems: Zero-Sum Games , Minimax Algorithm , Alpha-Beta Pruning , Expectimax for Stochastic Games , Monte Carlo Tree Search (MCTS) Case Study: Chess, Go, Tic-Tac-Toe	**12**

3	**Knowledge Representation & Reasoning** **Logic-Based Knowledge Representation** Propositional Logic: Syntax, Semantics, Truth Tables , Logical Equivalences and Inference Rules . First-Order Predicate Logic (FOPL): Constants, Variables, Predicates, Quantifiers , Unification Algorithm , Forward and Backward Chaining , Resolution and Refutation **Classical AI Planning** Components of a Planning Problem: States, Actions, Goals , STRIPS Representation , PDDL (Planning Domain Definition Language) , Forward State-Space Planning , Backward State-Space Planning , Goal Stack Planning , Hierarchical Task Networks (HTN) **Probabilistic Reasoning & Uncertainty in AI** Probability Basics for AI (Random variables, distributions), Bayesian Reasoning, Bayes Theorem, Naïve Bayes Classifier, Bayesian Networks, Hidden Markov Models, Decision Theory	**9**

4	**NEURAL NETWORK** **Introduction to Neural Networks** Biological Neuron vs Artificial Neuron, History and Evolution of Neural Networks, Basic Structure of an Artificial Neural Network (ANN), Weights, Biases, and Layers (Input, Hidden, Output), Types of Neural Networks: Overview **Perceptron** Single Layer Perceptron: Architecture and Working ,Perceptron Learning Rule, Limitations of Single Layer Perceptron (XOR Problem), Multi-Layer Perceptron (MLP), McCulloch–Pitts model of neuron, Rosenblatt's perceptron **Activation Functions** Need for Activation Functions, Step Function, Sigmoid Function, Tanh (Hyperbolic Tangent) Function , ReLU (Rectified Linear Unit), Leaky ReLU and Parametric ReLU, Softmax Function (Output Layer) **Architectures of Neural Network** Single-layer feed forward network, Multi-layer feed forward ANNs, Competitive network, Recurrent network	**8**

5	**Reinforcement learning , Multi-Agent Systems & Ethics** **Reinforcement learning** Agent–Environment interaction, Reward, Policy, Value Function, Markov Decision Process (MDP), Q-Learning, Applications **Multi-Agent Systems (MAS)** Definition and Properties of Multi-Agent Systems , Types of Agents: Cooperative, Competitive, Mixed , Communication and Coordination in MAS , Distributed Problem Solving , Game Theory in AI: Nash Equilibrium, Prisoner's Dilemma , Auction Mechanisms and Social Choice Theory , Applications: Traffic Control, Swarm Intelligence, Logistics **Robotics & Autonomous Systems** AI in Robotics: Sensing, Perception, Actuation , Simultaneous Localization and Mapping (SLAM) , Motion Planning: RRT, A* for Robots , Human-Robot Interaction (HRI) , Autonomous Vehicles: Architecture and Challenges **Explainable AI & Ethics** Need for Transparency and Explainability in AI , LIME (Local Interpretable Model-Agnostic Explanations) , SHAP (SHapley Additive exPlanations) , Bias, Fairness, and Accountability , Privacy, Surveillance, and Misuse of AI , AI Regulations: GDPR, EU AI Act, India's NITI Aayog AI Policy , Responsible and Sustainable AI Development	**8**

- **Course Outcomes:**

  CO1 - Apply appropriate state-space representations, search strategies (uninformed, informed, local, and adversarial), and problem formulation techniques to solve classical AI problems and game-playing scenarios.
  CO2 - Analyze the performance, completeness, optimality, and computational complexity of various AI search algorithms, heuristic functions, and adversarial strategies under different problem environments.
  CO3 - Apply logic-based knowledge representation (Propositional Logic, FOPL), planning formalisms (STRIPS, PDDL), fuzzy inference systems, and neural network models to model real-world problems and analyze their reasoning mechanisms.

CO4 - Analyze neural network architectures, learning rules, activation functions, and multi-agent system interactions; evaluate their suitability, strengths, and limitations for specific AI applications such as robotics, expert systems, and autonomous systems.

CO5 - Evaluate AI systems with respect to explainability, fairness, ethical implications, regulatory frameworks, and societal impact, and justify the adoption of responsible AI practices in practical deployments.

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- **Course Outcomes – Program Outcomes Mapping Table :**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	1	–	–	1
CO2	2	3	2	2	–	–	–	1
CO3	3	2	3	3	1	–	–	2
CO4	2	3	3	3	2	1	–	2
CO5	–	2	2	2	1	1	3	2

- **Text Book :**

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 4th Edition, Pearson Education, 2021 , ISBN: 978-0134610993
2. Ethem Alpaydin, Introduction to Machine Learning, 4th Edition, MIT Press, 2020. ISBN: 978-0262043793
3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2017. ISBN: 978-0070428072
4. Artificial Intelligence – Elaine Rich, Kevin Knight & Shivashankar Nair, McGraw Hill.

- **Reference Books :**

1. Machine Learning – Tom M. Mitchell, McGraw Hill.
2. Deep Learning – Ian Goodfellow, Yoshua Bengio & Aaron Courville, MIT Press.
3. Pattern Recognition and Machine Learning – Christopher M. Bishop, Springer.
4. Artificial Intelligence: Foundations of Computational Agents – David Poole & Alan Mackworth, Cambridge University Press.

- **Web References :**

1. https://www.geeksforgeeks.org/artificial-intelligence/
2. https://scikit-learn.org/stable/
3. https://www.ibm.com/think/topics/machine-learning
4. https://onlinecourses.nptel.ac.in/noc26_cs74/preview
5. https://www.datacamp.com/blog/what-is-machine-learning

- **App References :**

- Coursera
- Udemy
- Kaggle

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- **Syllabus Coverage from text /reference book & web/app reference:**

Unit	Book Number	Chapter Numbers
1	1,2,3	**Book 1:** Ch. 1, 2.1–2.4 **Book 2:** Ch. 1.1–1.4 **Book 3:** Ch. 1–2
2	1,3	**Book 1:** Ch. 3.1–3.6, Ch. 4.1–4.6 **Book 3:** Ch. 3, 4.2–4.7
3	1,2,3	**Book 1:** Ch. 7.1–7.8 **Book 2:** Ch. 4.1–5.5 **Book 3:** Ch. 6.1–7.5
4	2,3	**Book 2:** Ch. 5.1–5.9 **Book 3:** Ch. 7.1–7.4
5	1,2,3	**Book 1:** Ch. 25.1–25.4 **Book 2:** Ch. 12.1–12.5 **Book 3:** Ch. 3.2–3.4

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Practical List

Note: The program can be implemented in any language as per the choice of the students. Preferred language is Python.

1. Implement Breadth First Search (for 8 puzzle problem).
2. Implement Breadth First Search (for Water Jug problem).
3. Implement Depth First Search (for 8 puzzle problem).
4. Implement Depth First Search (for Water Jug problem).
5. Write a program to solve Tower of Hanoi problem
6. Write a program to implement Single Player Game (Using Heuristic Function).
7. Implement Two Player Game - Tic-Tac-Toe (Using Heuristic Function).
8. Write a program to solve N-Queens problem.
9. Write a program to solve travelling salesman problem.
10. Develop any Rule based system for an application of your choice.
11. Develop an Expert system for medical diagnosis.