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
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,	8

	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	
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**

FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS

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.

FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS

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.

FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS

o 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

o 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.

o 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.

o 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

o App References :

- Coursera
- Udemy
- Kaggle

FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS

- **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

Marwadi University
Marwadi Chandarana Group

NAAC A+

FACULTY OF COMPUTER APPLICATIONS
MASTER OF COMPUTER APPLICATIONS
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.