Course Code: CS205B	Course Name: AI and Its Application	L	T	P	C
Course Offered in: CSE/CS/CSIT		3	0	2	4

Pre-requisite: Python Programming

Course Objectives:

1. To provide students with a foundational understanding of Artificial Intelligence (AI) concepts, tools, and practical implementations, including search algorithms, knowledge representation, and ethical considerations.
2. To equip students with hands-on experience in designing and implementing agentic AI systems, genetic algorithms, and their real-world applications across diverse domains such as healthcare, finance, and robotics.

Course Outcome: After completion of the course, the student will be able to

1. Demonstrate foundational understanding of Artificial Intelligence, its key domains, tools, and ethical implications by implementing logic-based systems and classical search algorithms
2. Design and simulate intelligent agents and multi-agent systems in diverse environments, incorporating concepts of decision-making, utility, and communication strategies.
3. Apply reinforcement learning techniques to develop learning agents and multi-agent environments, and visualize their behavior in real-world-inspired simulations and games.
4. Construct and optimize Genetic Algorithm-based solutions to solve complex real-world problems such as scheduling, path planning, and feature selection, while exploring hybrid and advanced evolutionary strategies.

CO-PO Mapping (Scale 1: Low, 2: Medium, 3: High)

CO-PO Mapping	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO1	PSO 2
CO1	3	3	2	3	3	1						2	2	-
CO2	2	3	3	2	3	1						2	2	-
CO3	2	3	3	2	2	1						3	2	-
CO4	1	2	2	3	2	3						3	2	-

Unit 1	Practical Foundations of Artificial Intelligence	18 hours

Introduction to AI and its Tools & Libraries

Definition, History, and Evolution of AI, Key Domains: Machine Learning, Deep Learning, NLP, Computer Vision, AI

Applications in Healthcare, Finance, and Robotics

Python for AI: NumPy, Pandas, and Scikit-learn

Introduction to TensorFlow/PyTorch

Using Jupyter Notebooks for Experiments

Search Algorithms with Implementation

Uninformed Search Strategies: BFS, DFS, Informed Search Strategies: A*, Greedy Best-First Search

Constraint Satisfaction Problems (CSPs)

BFS & DFS Implementation in Python

Developing a Maze Solver using Search Algorithms

Implementing A* Algorithm for Path Planning

Knowledge Representation & Ethics

Propositional Logic and First-Order Logic, Knowledge Graphs and Ontologies

Responsible AI Practices, Challenges of Fairness, Transparency, and Explainability

Implementing Logic-Based Systems with Python Libraries

Building a Rule-Based Expert System

Mini Projects:

Implement a Tic-Tac-Toe AI using Minimax Algorithm

Create a Pathfinding Visualizer for BFS/DFS/A*

Unit 2	Foundations of Agentic AI and Intelligent Agents	19 hours

Introduction to Agents and Agent Environments

Definition and Characteristics of Agents

Types of Agents: Reflex, Goal-Based, Utility-Based

Agent Environments: Fully vs. Partially Observable

Designing and Implementing Simple Agents in Python (4 hours)

Build Reflex and Goal-Based Agents

Smart Vacuum Cleaner Simulation
Self-Navigating Agent in a Virtual Grid
3. Multi-Agent Systems and Distributed AI (3 hours)
Overview of Multi-Agent Systems (MAS)
Coordination and Communication in MAS
Real-World Applications: Smart Grids, Collaborative Robot
4. Decision-Making and Agent Intelligence (4 hours)
Introduction to Markov Decision Processes (MDPs)
Basics of Game Theory and Nash Equilibrium
Designing Rule-Based Decision Logic
Mini Project: Build a Reflex Agent for Maze Navigation

Unit 3	**Learning Agents and Practical Agentic AI Systems**	**19 hours**

Learning Agents and Reinforcement Learning
Learning Agents: Characteristics and Architectures
Reinforcement Learning Fundamentals
Introduction to OpenAI Gym
Implementing RL Algorithms
Q-Learning: Concepts and Python Implementation
Deep Q-Networks (DQN): Architecture and Training
Visualizing Agent Learning Progress
Agentic AI for Games and Simulation
Develop AI Agent for Snake or Flappy Bird
Case Study: Self-Learning Bot in a Custom Game
Reward Shaping and Environment Design
Advanced Multi-Agent Learning and Simulations
Cooperative and Competitive Agents
Traffic Control Simulation using Multi-Agent Systems
Reinforcement Learning in Multi-Agent Scenarios

Mini Projects -Solve Frozen Lake Environment using Q-Learning

Unit 4	**Genetic Algorithms & Applications**	**19 hours**

Fundamentals of Evolutionary Computation
Introduction to Evolutionary Algorithms
Darwinian Principles: Selection, Mutation, Crossover
Genetic Algorithm Workflow and Structure
Core Components of Genetic Algorithms
Chromosome Representation Techniques
Fitness Functions and Selection Strategies
Crossover Techniques (One-point, Two-point, Uniform)
Mutation Methods
Implementing Genetic Algorithms in Python
Writing a Basic GA from Scratch
Custom Fitness Function Design
Visualizing GA Evolution with Matplotlib
Advanced Techniques and Hybridization (3 hours)
Elitism and Diversity Preservation
Parameter Tuning for Performance Optimization
Hybrid GAs: Integration with Local Search and Simulated Annealing
Introduction to Memetic Algorithms

Practical Applications
Solving the Traveling Salesman Problem (TSP)
Feature Selection in Machine Learning

Scheduling and Resource Allocation Problems
Autonomous Route Planning (e.g., for vehicles or drones)
Mini Project - Solve Optimal Timetable Scheduling for a University

Total Lecture Hours	**75 hours**

Online Resource: NPTEL's free AI Course by Prof. Deepak Khemani, IIT Madras

Textbook:

1. Subrata Saha (PHI Learning)
2. Manaranjan Pradhan & U. Dinesh Kumar (Wiley India)
3. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.
4. I. Bratko, ―Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers
5. M. Tim Jones, ―Artificial Intelligence: A Systems Approach(Computer Science)‖, Jones and Bartlett Publishers, Inc.;First Edition, 2008
6. Nils J. Nilsson, ―The Quest for Artificial Intelligence‖, Cambridge University Press, 2009.
7. William F. Clocksin and Christopher S. Mellish,‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition,Springer, 2003.
8. Gerhard Weiss, ―Multi Agent Systems‖, Second Edition, MIT Press, 2013.
9. David L. Poole and Alan K. Mackworth, ―Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

Reference Books:

1. Artificial Intelligence, Rich and Knight, (TMH)
2. Artificial Intelligence with Python" Prateek Joshi (Indian Author, Packt Publishing)

Mode of Evaluation

MSE		**CA**			**ESE**	**Total**
MSE1 40	**MSE2 40**	**CA1**	**CA 2**	**CA3 (ATT)**		
80		**8**	**8**	**4**	**100**	**200**