***CSXX02*68: Autonomous MultiAgent Systems**

L-T-P-Cr: 3-0-0-3

Prerequisites: Artificial Intelligence, Data Structures and Algorithms, Probability & Linear Algebra

Course Outcomes:
At the end of the course, a student should have:

Sl. No.	Outcome	Mapping to POs
1.	Understand the foundational principles of agents and multi-agent systems, including their architecture and characteristics.	PO1, PO12
2.	Analyze and design coordination, cooperation, and negotiation mechanisms among multiple autonomous agents.	PO1, PO2, PO3, PO9, PO10, PO12
3.	Apply game theory, communication protocols, and learning techniques in multi-agent system design.	PO2, PO3, PO4, PO5, PO12
4.	Implement simulations and real-world applications of multi-agent systems in domains such as robotics, traffic control, and smart grids.	PO1-PO7, PO9-PO12
5.	Develop problem-solving and research skills through projects, enabling students to explore emerging trends in distributed AI and intelligent systems.	PO1-PO5, PO8-PO12

Unit 1 — 10 Lectures

Introduction to Multi-Agent Systems, Definition and characteristics of agents and multi-agent systems, Differences between single-agent and multi-agent systems, Applications and case studies (e.g., swarm robotics, game AI, smart cities), Agent Architectures and Decision-Making, Reactive, Deliberative, Hybrid architectures, BDI (Belief-Desire-Intention) models,
Utility-based decision-making, Autonomy and rationality

Unit 2 — 12 Lectures

Agent Communication and Interaction, Communication languages: KQML, FIPA-ACL, Ontologies and protocols, Coordination strategies and distributed problem-solving, Cooperation, Negotiation, and Game Theory, Cooperative vs. Competitive agents,

Coalition formation, task allocation, Basics of game theory: Nash Equilibrium, Prisoner's Dilemma, Mechanism design and auctions

Unit 3 — 12 Lectures

Learning in Multi-Agent Systems, Reinforcement learning in multi-agent settings, Multi-agent Q-learning, Emergent behavior, Credit assignment and reward sharing, Planning and Coordination, Distributed planning and task scheduling, Temporal and resource constraints, Consensus algorithms

Unit 4 — 5 Lectures

Swarm Intelligence and Bio-Inspired Systems, Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Self-organization and stigmergy, Collective robotics and behavior modeling

Unit 5 — 3 Lectures

Case Studies and Applications, Smart grid systems, Autonomous vehicle coordination, Distributed sensor networks

Text Books:

1. Gerhard Weiss, “Multiagent Systems,” 2nd Edition (Intelligent Robotics and Autonomous Agents series), MIT Press

Reference Books

1. Michael Wooldridge, “An Introduction to MultiAgent Systems,” 2nd Edition, Willey Publication
2. Yoav Shoham, Kevin Leyton-Brown, “Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations,” Cambridge University Press