AUTONOMOUS SYSTEMS

Course Code		Year	IV	Semester	I
Course Category	PE -V	Branch	ME	Course Type	Theory
Credits	3	L – T – P	3 – 0 – 0	Prerequisites	Basic Control Systems
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

CO	Statement	Skill	BTL	Units
CO1	Understand the structure and functioning of intelligent agents and multi-agent systems for collaborative autonomous tasks.	Understand, Communication	L2	1
CO2	Analyze and differentiate architectural features and levels of autonomy in various autonomous systems.	Analyze, Problem Solving	L3–L4	2
CO3	Model and apply control techniques to unmanned vehicles considering dynamics and motion constraints.	Apply, Analyze	L3–L4	3
CO4	Identify and evaluate sensors and actuators, and apply basic sensor fusion techniques.	Understand, Apply	L2–L3	4
CO5	Apply control algorithms and motion planning strategies for aerial robots including navigation and trajectory tracking.	Apply, Analyze	L3–L4	5

Contribution of Course outcomes towards achievement of Program outcomes & Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	2					1		3	
CO2	3	3	2	2	3					1		3	2
CO3	3	3	3	3	3				1	1		3	3
CO4	3	3	2	3	3				2	2		3	3
CO5	3	3	3	3	3				2	2		3	3

Syllabus		
UNIT	Contents	Mapped CO
I	**INTRODUCTION TO AGENT SYSTEMS:** Introduction to Agents, Agent Architectures, and Multi-agent Systems and Society of Agents, Distributed Problem Solving and Planning, Case Study: Collaborative Robotics, Robocup	CO1
II	**ARCHITECTURE OF AUTONOMOUS SYSTEMS:** Degree of Autonomy, Reactive Systems, Real-time Systems, Architecture of AGVs , AUVs, Drones, Tele-Operation, AR, VR applications	CO2
III	**CLASSIFICATION, MODELLING, AND CONTROL ASPECTS OF UNMANNED VEHICLES:** Different types of unmanned vehicles: ground (wheeled and legged), aerial (fixed, flapping, and rotary wings), underwater vehicles , Modelling of unmanned vehicles considering basic forces, kinematics, and dynamics, Discussion on different types of control for aerial, underwater (fins and propulsion control), ground (biped and quadruped motion control for	CO3

	legged robots)	
IV	**SENSORS AND ACTUATORS:** Types of sensors used in unmanned vehicles (proximity, IMU, magnetometers, thermal imaging, vision, LiDAR, GPS, RTK, etc.) and their characteristics, Sensor data aggregation, processing, and sensor fusion, Introduction to popular computing platforms for data processing, Types of actuators: motors, servos, harmonic drive, linear actuators	**CO4**
V	**FLIGHT CONCEPTS:** Basic Aerial Robot Flight Concepts, Micro-aerial vehicle, Frame Rotations and Representations, Aerial robots equations of motion, State-Space Form, Time, Motion, and Trajectories, Linearization,2-D and 3-D control of Aerial robots, PID Control, LQR control, Motion planning, Collision-free Navigation, Sensing and Estimation, Vision-based Guidance for aerial robots, Introduction to Communication and Networking Protocols.	**CO5**

Learning Resource
Text books:
1. Roland Siegwart, Illah Reza Nourbakhsh, DavideScaramuzza(2018),Introduction to autonomous mobile robots, MIT press. 2. Gerhard Weiss ed. (2013), Multiagent System, Second Edition, MIT Press
Reference books:
1. C. Venkatesan, (2014), Fundamentals of Helicopter Dynamics, 1st Edition, CRC Press 2. John D. Anderson, (2015), Introduction to Flight, 8th Edition, McGraw-Hill Education