GUJARAT TECHNOLOGICAL UNIVERSITY

Master of Engineering
Subject Code: 3725411
Semester – II
Subject Name: Robotics & Intelligent Systems

Type of course: Program Elective III

Prerequisite: Mathematics and Computational fundamentals

Rationale: In this course of *Robotics and Intelligent Systems*, students of PG studies learn a working knowledge of methods for design and analysis of robotic and intelligent systems. Particular attention is given to modeling dynamic systems, measuring and controlling their behavior, and making decisions about future courses of action. The content is necessarily broad, and the course level is introductory. The intent is to motivate and prepare students to conduct research projects and for further study through advanced courses in related areas.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**System Modeling:** Biological and Cognitive Paradigms for Robot Design, Declarative-Procedural-Reflexive Hierarchy for Decision-Making and Control, Articulated Robots, Joint-Link (Denavit-Hartenberg) Transformations, Mobile Ground Robots, Uninhabited Air Vehicles, Intelligent Agents.	**06**
2	**Control System Principles:** Open- and Closed-Loop Control, Time-domain and Frequency-domain Analysis, Optimality and Constraints, Stability and Performance, Adaptation, Control Actuation, Closed-form and Probabilistic Path Planning.	**06**
3	**Computing, Measurement, State, and Parameter Estimation:** Sensors and Sensing, Formal and Fuzzy Logic, Turing Machines and Concepts of Machine Learning, Analog and Digital Systems, Probability and Error Models, Sensor-Based Estimation, Extended Kalman and Particle Filters, Simultaneous Location and Mapping (SLAM).	**07**
4	**Decision-Making and Machine Learning:** Decision Trees, Bayesian Belief Networks, Classification of Data Sets, Task Planning for Individual and Multiple Agents, Regression.	**06**
5	**Numerical Methods for Evaluation and Search:** Monte Carlo Simulation, Genetic	**07**

	Algorithms, Simulated Annealing, Particle Swarm Optimization.	
6	**Expert Systems:** Production Systems, Forward Chaining, Backward Chaining.	**06**
7	**Neural Networks for Classification and Control :** Training and Implementation of Network Architectures, Feed-Forward Networks, Associative Networks, Cerebellar Model Articulation Controller, Deep-Learning Algorithms.	**07**

Reference Books:

1. Robotics and Intelligent Systems: A Virtual Reference Book
2. Autonomous Robots, G. Bekey, MIT Press, 2005
3. Martin, Fred G., "Robotic Explorations: An Introduction to Engineering through Design", Prentice Hall, 2001
4. Matarid, M.J., "The Robotics Primer", The MIT Press, Cambridge, Massachusetts, 2007
5. Schilling R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall.
6. McKerrow P. J., Introduction to Robotics, Addison-Wesley.
7. Siegwart R. and Nourbakhsh I. R., Introduction to Autonomous Mobile Robots, The MIT Press, 2004
8. Stadler W., Analytical Robotics and Mechatronics, McGraw-Hill

Course Outcomes:

After learning the course the students should be able:

Sr. No.	CO statement	Marks % weightage
CO-1	Design intellectual robot systems with learning/adaptive control system.	30
CO-2	Analyse various intelligent control systems.	30
CO-3	Evaluate task planning and problem solving capabilities of robot.	20
CO-4	Understand robotic systems for various commercial and industrial Applications.	20

List of Experiments: As per the above syllabus

Major Equipment / software: MATLAB (Latest Version)