

GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION (COMMUNICATION SYSTEMS ENGG) (05) ROBOTICS AND INTELLIGENT SYTEMS SUBJECT CODE: 2740502 M.E. 4TH SEMESTER

Type of course: Major Elective-V

Prerequisite: Control system.

Rationale:

This course will introduce the basic principles of mobile robotics history, theory, hardware and control. Topics will include robot components, effectors and actuators, locomotion, sensors, feedback control, control architectures, representation, localization and navigation.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
				ESE (E)	PA (M)	ESE (V)		PA (I)		
				ESE	OEP	PA	RP			
4	0	2#	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Robotic Systems: Overview and Preliminaries, Biological Paradigms, Robotic Manipulators Sensors and Actuators, Low-Level Robot Control, Mobile Robots, Modelling Dynamic Systems Kinematics and Dynamics of Rigid Bodies , Continuous- and Discrete-time Dynamic Models , Linearization and Linear Response, Controller hardware/software systems, Sensor systems and integration.	16	30%
2	Intelligent Systems: Continuous- and Discrete-time Dynamic Models: Formal Logic and, Linearization, Turing Machines and Linear Response, Predicate Calculus, Crisp and Fuzzy Sets, Expert Systems: Inference and Knowledge Representation, Probability Theory Introduction to Optimization and Numerical Optimization, Least-Squares Estimation Monte Carlo Evaluation and Evolutionary Algorithms Learning (Knowledge Acquisition) Classification of Data Sets	16	30%
3	Computational Neural Networks : Neural Networks, Training Neural Networks	12	20%
4	Goal-Oriented Control : Optimal Control, Robust, Adaptive, and Neural Control, Task Planning and Multi-Agent Systems	12	20%

Reference Books:

1. Autonomous Robots, G. Bekey, MIT Press, 2005

2. Arkin, Ronald C., "Behavior-Based Robotics", The MIT Press.
3. Jones, Joseph L., Flynn, Anita, M., and Seiger, B.A., "Mobile Robots: Inspiration to Implementation", AK Peters, 1999
4. Martin, Fred G., "Robotic Explorations: An Introduction to Engineering through Design", Prentice Hall, 2001
5. Matarid, M.J., "The Robotics Primer", The MIT Press, Cambridge, Massachusetts, 2007
6. Schilling R. J., Fundamentals of Robotics: Analysis and Control, Prentice Hall.
7. McKerrow P. J., Introduction to Robotics, Addison-Wesley.
8. Siegwart R. and Nourbakhsh I. R., Introduction to Autonomous Mobile Robots, The MIT Press, 2004.
9. Stadler W., Analytical Robotics and Mechatronics, McGraw-Hill.

Course Outcome:

After completing this course the student must demonstrate the knowledge and ability to:

1. To model robot manipulators and mobile robots
2. Solve an inverse kinematics problem and plan a robot trajectory
3. Design and analyze robot controllers by using appropriate methods
4. Design basic robot intelligent sensor systems including static system learning (kinematics) and dynamic learning; and intelligent course recognition.
5. Acquire skill in robot task planning for problem solving.
6. Develop skills in identifying areas in manufacturing where robotics can be deployed for enhancing productivity.

List of Experiments:

As per the above syllabus

Design based Problems (DP)/Open Ended Problem:

- Simulation of a robotic device
- Design and simulation of a neural network
- Design and simulation of an intelligent system
- Development of program for forward kinematics, Inward kinematics and trajectory Planning for any small scale industrial robot in nearby Industry/your own workshop.
- Robot cell design using simulation software environment for any real life application.
- Development of mobile robot for applications like Material handling, Inspection, Pick and Place operations using sensors and basic robot peripherals.

Major Equipment:

- Robocell Design softwares available online
- Programming using MATLAB

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.

