GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS (47)
ROBOTIC ENGINEERING (MECHATRONICS)
SUBJECT CODE: 2734702
M.E. 3rd SEMESTER

Type of course: Engineering Science

Prerequisite: - NA

Rationale: This subject deals with study of robot actuators, kinematics, dynamics and motion control of robotic manipulators which is useful for proper selection of robot actuators.

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)		
						ESE	OEP	PA	RP	
3	2#	2	5	70	30	20	10	10	10	150

Content:

Sr. No.	Content	Hours	Weightage
1	**General considerations of Robotic Manipulator** History of robot; Geometric configurations, work volumes and Degree of freedoms; Robot actuators and drives; Analysis of Robotic inaccuracies and resolutions.	08	19%
2	**Kinematics of Robotic Manipulator** Service Index of different configurations; Homogeneous transformation; Direct Kinematic; Inverse Kinematics; D-H representation.	08	19%
3	**Forces in Manipulators** Statics and dynamics; considerations of forces, moments and torques for various basic robotic configurations; Counter balancing systems	10	24%
4	**Trajectory Generation** Cubic polynomials; Higher order polynomials; Linear function with parabolic blends; numerical based on different motion trajectories.	06	14%
5	**Motion Control of Robotic manipulators** Robotic open and closed loop control systems, Second order systems, Non – linear closed loop equation of motion, Error controlled Robotic dynamics, Control of Single axis robotic arm, Generalized motion control laws for robotic manipulators, Common control system for industrial robots, simple robotic manipulator, Independent joint PID control, Independent joint PID control with effective joint inertia, Force control of robotic manipulator, Tracking error analysis, Coordinated movement	10	24%

Reference Books:

1. A Robot Engineering Textbook ,Mohsen Shahinpoor, Harper and Row, Publisher, New York
2. Mechanical Design of Robots , Eugene I. Rivin, McGraw Hill Book Company, New York

3. Introductin to Robotics: Analysis, Control, Applications Saeed Niku, John Wiley & Sons
4. Introduction to Robotics S K Saha, Tata McGraw-Hill

Course Outcome:

1. Students will understand the workspace and degree of freedom of various robot configurations.
2. Students will learn about forward and inverse kinematics of robotic manipulators.
3. Students will able to calculate static and dynamic forces and torques of manipulator. This will help in selection of robotic actuators.
4. Students will understand the trajectory generation of robotic manipulators.
5. Students will able to select the various controllers of robotic manipulators.

List of Experiments:

Experiments based on robot workspace, robot kinematics, robot dynamics, trajectory generation and robot motion control using robotic software.

Design based Problems (DP)/Open Ended Problem:

Students may be given a task to exhibit the knowledge of the course studied during the academic year.

Major Equipments:

Industrial robot or any other mechanism may be used for the performance of experiments.

List of Open Source Software/learning website:

RoboAnalyzer

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.