GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3172513
SUBJECT NAME: Robotics
B.E 7th SEMESTER

Type of Course: - Professional Elective

Pre-requisite:-

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

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	**Fundamentals of Robotics** Automation - Concept, Need, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, History of robot; Application of Robot, Advantages and Disadvantages of Robots, Robot Components, Robot Degrees of Freedom, Geometric configurations, Robot Joints, Robot Coordinates Robot Reference Frames Work volumes, and Degree of freedoms; Analysis of Robotic inaccuracies and resolutions.	**08**
2	**The Robot and its Peripherals** **Control Systems and Components:** Basic Control Systems Concepts and Models, Controllers, Control System Analysis, Robot Sensors and Actuators, Velocity Sensors, Actuators. **Robot End Effectors :** Types of End Effectors, Mechanical Grippers, Other Types of Grippers, Tools as End Effectors, The Robot/End Effector Interface, Considerations in Gripper Selection and Design **Sensors in Robotics:** Transducers and Sensors, Sensors in Robotics, Tactile Sensors, Proximity and Range Sensors, Miscellaneous Sensors and Sensor Based Systems, Uses of Sensors in Robotics	**08**

3	**Kinematics of Robotic Manipulator : Position Analysis** Introduction, Robots as Mechanisms, Matrix Representation, Homogeneous Transformation Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots, Forward and Inverse Kinematic Equations: Position, Forward and Inverse Kinematic Equations: Orientation, Forward and Inverse Kinematic Equations: Position and Orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots up to 6 DOF robots, The Inverse Kinematic Solution of Robots, Degeneracy and Dexterity	**10**
4	**Trajectory Generation** Basics of trajectory planning, Joint space vs. Cartesian space descriptions, Joint space trajectory planning, Cubic polynomials; Higher order polynomials; Linear function with parabolic blends; Numerical based on different motion trajectories, Cartesian space trajectories.	**05**
5	**Applications Engineering for Manufacturing** Robot Cell Design and Control, Robot Cell Layouts, Multiple Robots and Machine Interference, Other Considerations in Workcell , Workcell Control, Interlocks, Error Detection and Recovery, The Workcell Controller, Robot Cycle Time Analysis, Economic Analysis for Robotics	**06**
6	**Robot Applications in Manufacturing** Material Transfer and Machine Loading/Unloading, Processing Operations, Assembly and Inspection	**06**

Reference Books:

1. Introduction to Robotics: Analysis, Control, Applications, Saeed Niku, John Wiley & Sons.
2. Industrial Robotics: Technology, Programming and Applications, Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey, Ashish Dutta, Tata McGraw Hill Education Private Limited
3. Introduction to Robotics, S K Saha, Tata McGraw-Hill.
4. Robotics control, sensing, vision and intelligence, K S Fu, R C Gonzalez, CSG Lee, Tata McGraw Hill Edition.
5. Introduction to robotics, John J Craig, Pearson/Prentice Hall, Third edition.

Distribution of marks weightage for cognitive level

Bloom's Taxonomy for Cognitive Domain	Marks % weightage
Recall	20
Comprehension	20
Application	20
Analysis	20
Evaluate	20
Create	-

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Course Outcome:

After learning the course students will be able to:

Sr. No.	Course Outcome	Percentage weightage
CO-1	Summarize the workspace and degree of freedom of various robot configurations.	20%
CO-2	Choose proper grippers, sensors and controllers for robots as per application.	20%
CO-3	Dissect forward and inverse kinematics of robotic manipulators.	20%
CO-4	Organize the trajectory generation of robotic manipulators	20%
CO-5	Evaluate the use of robots in manufacturing processes.	20%

List of Experiments:

1. Study of robot workspace and DOF for different applications.
2. Selection of robot end effectors, sensors and controllers for different applications.
3. Forward and inverse kinematics of robot manipulators.
4. Trajectory planning of manipulators for specific tasks.
5. Study of robot application in manufacturing processes.
6. Robot kinematic study using RoboAnalyzer software.

List of Open Source Software/learning website:

NPTEL Course

RoboAnalyzer, Scilab