

GUJARAT TECHNOLOGICAL UNIVERSITY

SUBJECT: PRINCIPLES OF ROBOTICS

SUBJECT CODE: 2154102

B.E. 5th Semester

Type of course: Professional Core Course

Prerequisite: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	0	2	5	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	BASIC CONCEPTS: Brief history-Types of Robot-Technology-Robot classifications and specifications-Design and control issues-Variou manipulators – Sensors - work cell - Programming languages.	9	20%
2	DIRECT AND INVERSE KINEMATICS: Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Variou joints-Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics-Inverse kinematics-SCARA robots- Solvability – Solution methods-Closed form solution.	9	20%
3	MANIPULATOR DIFFERENTIAL MOTION AND STATICS: Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints-Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.	9	20%

4	PATH PLANNING: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.	9	20%
5	DYNAMICS AND CONTROL: Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.	9	20%

Reference Books:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

Course Outcomes:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.