Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3154102 Date:28-05-2025

Subject Name:Principles of Robotics

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	What is the importance of feedback sensors in a robot's control system?	**03**
	(b)	What is the role of simulation and modeling in robot programming?	**04**
	(c)	What was the significance of the industrial revolution in the development	**07**
Q.2	**(a)**	Define the concept of degrees of freedom (DOF) in robotics.	**03**
	(b)	Define homogeneous transformation matrices in the context of robotics.	**04**
	(c)	Describe the process of calculating the end-effector position and orientation using direct kinematics.	**07**
		OR	
	(c)	What does SCARA stand for, and how do SCARA robots differ from other robotic configurations? Provide an example of an industry or application where SCARA robots are commonly used.	**07**
Q.3	**(a)**	Differentiate between prismatic and rotary joints in terms of their motion.	**03**
	(b)	Explain the difference between forward kinematics and inverse kinematics in robotics.	**04**
	(c)	Describe the importance of static analysis in robot design and control. Also explain the role of load distribution in static analysis.	**07**
		OR	
Q.3	**(a)**	Define linear velocity and angular velocity in the context of robotics.	**03**
	(b)	How is the Jacobian matrix used to relate joint velocities to end-effector velocities?	**04**
	(c)	What is meant by force and moment balance in the context of robot manipulation? How a robot maintains force and moment balance during a task.	**07**
Q.4	**(a)**	What is the joint space of a robot, and why is it essential for robot control?	**03**
	(b)	How can cubic polynomials be used to create smooth robot trajectories?	**04**
	(c)	What difficulties arise when creating a path for complex robotic systems with multiple degrees of freedom?	**07**
		OR	
Q.4	**(a)**	Describe the characteristics of a straight line path for a robot's end-effector.	**03**
	(b)	What is orientation planning and how is it used in path planning?	**04**
	(c)	What are the benefits and drawbacks of the Cartesian space technique and how is it applied to path planning?	**07**
Q.5	**(a)**	Define Lagrangian mechanics and its role in robotics.	**03**
	(b)	How does a PID controller work to maintain a desired setpoint in robotic systems?	**04**
	(c)	Give a brief explanation of the difficulties in creating control systems for manipulators that have multiple degrees of freedom in robotics.	**07**

OR

Q.5	**(a)**	What is the advantage of using the Lagrange-Euler formulation over other dynamic modeling methods?	**03**
	(b)	What are the advantages of linear control over nonlinear control in certain applications?	**04**
	(c)	What are the limitations of feedback control systems and how are they used in robotics?	**07**

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