

Enroll No

K.E.Society's
Rajarambapu Institute of Technology, Rajaramnagar
 (An Autonomous Institute, affiliated to SUK)
 End Semester Examination
 T.Y.B.Tech. Robotics & Automation V

Q.P. Code
E 1316

Course Code: RAMD 301

Course Name: Kinematic and Dynamic of Robots

Day & Date: *Friday 14/11/2025*

Time : *10:30 To 1:30*

Max Marks: 100

- Instructions:**
- 1) All questions are compulsory.
 - 2) Figures in rounded () brackets within the question, indicate the scheme of marking for respective part of the question, whereas, figures in the first right column indicate total marks for that whole question.
 - 3) CO is the index number of the Course Outcome statement.
 - 4) The Bloom's taxonomy level (BL) for 1,2,3,4,5 and 6 is remember, understand, apply, analyze, evaluate and create respectively.
 - 5) Assume suitable data if necessary.
 - 6) Use of non-programmable calculators is allowed.

Q.No.	Question Statement	Max Marks	CO No.	BT Level
Q.1	(a) Construct the homogeneous transformation matrix for a body rotated by 90° about the X-axis (4) and translated by (0, 150 mm, 200 mm).(4)	8	CO1	3
OR				
	(a) Construct the transformation matrix for a frame rotated by 30° (about the Y-axis (4) and translated by (100 mm, 0, 50 mm) with respect to the base frame. (4)	8	CO1	3
	(b) Apply the concepts of kinematic link (3), kinematic pair (2), and kinematic chain with its types to a fundamental system.(2)	7	CO1	3
Q.2	(a) Analyze the functional mechanism and major components of adhesive grippers used in robotic handling systems. (3) Apply appropriate selection parameters to choose a suitable adhesive gripper for handling objects with different surface finishes and material properties. (4)	7	CO4	4
OR				
	(a) Examine the operating principle and essential components of a mechanical gripper system. (3) Assess the key design parameters and selection criteria influencing the performance of mechanical grippers for handling objects of varying shapes, sizes, and materials. (4)	7	CO4	4
	(b) A manufacturing unit must automate the handling of fragile glass components. Recommend a suitable gripper type and justify your choice (3). Select an appropriate drive system based on accuracy and load requirements (3), and outline safety features to ensure damage-free operation (2).	8	CO4	3
Q.3	(a) Define Denavit-Hartenberg (D-H) parameters(3) and explain each type with a neat diagram.(4)	7	CO2	2

OR



Q.No.	Question Statement	Max Marks	CO No.	BT Level
	(a) Define forward and inverse kinematics. (3) Derive the general homogeneous transformation matrix for a robot manipulator.(4)	7	CO2	2
	(b) A 2-link planar manipulator has link lengths $L_1 = 0.8$ m, $L_2 = 0.4$ m. Using the D–H convention, (4) calculate the end-effector position (x, y) for joint angles $\theta_1 = 30^\circ$, $\theta_2 = 60^\circ$.(4)	8	CO2	3
Q.4	(a) Derive the expressions for joint angles w.r.t to the inverse kinematics for a 2-link planar manipulator. (7)	7	CO3	3
	OR			
	(a) Derive the expressions for joint angles w.r.t to the inverse kinematics for a 3-link planar manipulator (7)	7	CO3	3
	(b) Analyze the different types of robot kinematics and their coordinate systems. (4) Illustrate all axis rotational coordinate systems (X, Y, Z) with neat sketches showing their transformations. (4)	8	CO3	4
Q.5	(a) Investigate the condition number of a manipulator's Jacobian as a measure of manipulator performance. (4) Analyze singularity configurations in robotic manipulators and their impact on robot motion. (3)	7	CO5	4
	OR			
	(a) Examine the six independent motions of a rigid body in 3D space . (4) Differentiate between translational and rotational motions (3)	7	CO5	4
	(b) Define a screw transformation and its mathematical condition (4). What is the pitch of a screw and what does it represent? (4)	8	CO5	4
	(c) Apply the concept of rank loss in the Jacobian matrix (3) to identify singular configurations in a robotic manipulator.(2)	5	CO5	3
Q.6	(a) Demonstrate the kinematics of a rigid body in detail. (3) Classify the different types of rigid body motion and describe each with suitable examples.(4)	7	CO6	3
	OR			
	(a) Illustrate the term correction couple (3) and its significance in balancing rotating systems..(4)	7	CO6	3
	(b) Compare the Newton–Euler, Lagrange–Euler, and D'Alembert (4) methods for deriving equations of motion for robot manipulators. (4)	8	CO6	4
	(c) Determine the relationship between the Geometric and Analytical Jacobian Methods in robot kinematics. (5)	5	CO6	3

