

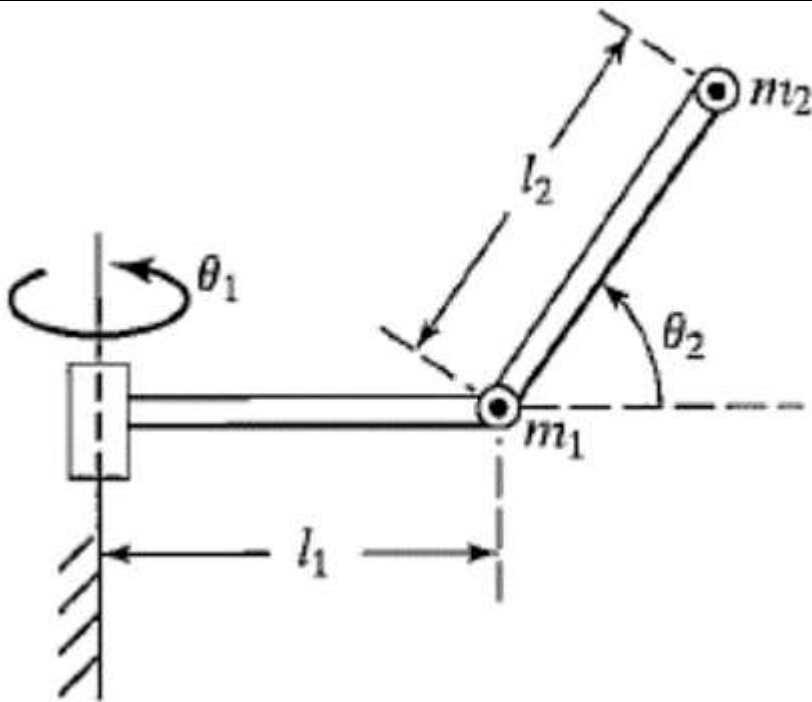
ODD SEMESTER EXAMINATION, 2023 – 24
II year B.Tech. – E&CE/AI&ML
Mechanics of Robotics

Duration: 3:00 hrs

Max Marks: 100

Note: - Attempt all questions. All Questions carry equal marks. In case of any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.

Q 1.	Answer any four parts of the following. a) Explain the fundamental rotation matrices. b) Explain any two Robot specifications. c) Describe the desirable features of sensors? What are the basic classifications of sensors? d) List the pros and cons involved in linear and nonlinear control of robot manipulation. e) What is the inverse transformation and how should it be interpreted? f) Explain the mechanism of robot wrist.	5x4=20
Q 2.	Answer any four parts of the following. a) Describe the functions of the robot. b) Explain the different steps in trajectory planning. c) List any three advantages and disadvantages of a hydraulic actuator d) Briefly explain the types of tactile sensors in robotics. e) Explain the function of machine vision system with block system representation. f) Explain mechanical grippers and their linkage mechanisms with neat sketches.	5x4=20
Q 3.	Answer any two parts of the following. a) Explain the following terms: 1. Accuracy 2. Degree of freedom 3. Repeatability 4. Speed b) Discuss in detail the Denavit–Hartenberg (DH) Convention for assigning frames to links for identifying the joint link parameters. Analyze in detail about the four DH parameters in Robot Kinematic modelling. c) Derive the inverse kinematics of the manipulator shown in Fig.	10x2=20



<p>Q 4.</p>	<p>Answer any two parts of the following.</p> <p>a) Derive forward & inverse kinematics equations of manipulator for a particular position.</p> <p>b) A point $P(2, 3, 4)^T$ is attached to a rotating frame. The frame rotates 90 degrees about the x-axis of the reference frame. Find the coordinates of the point relative to the reference frame after the rotation, and verify the result graphically.</p> <p>c) Analyze in detail about the end effector types and its selection procedures for a particular application of Robot on your own choice.</p>	<p>10x2=20</p>
<p>Q 5.</p>	<p>Answer any two parts of the following.</p> <p>a) For the point $[3 \ 7 \ 5]$ perform the following operations:</p> <ol style="list-style-type: none"> Rotate 30° about X-axis Translate 8 units along y-axis Rotate 30° about x then translate 6 units along Y- axis. Rotate 90° about z-axis. <p>b) Define Jacobian and Write the manipulator Jacobian matrix for the 3-DOF articulated arm with suitable example.</p> <p>c) Derive the expression for the velocity of the tip of the two link, planar, RR manipulator arm.</p>	<p>10x2=20</p>
