

Code: MEMD2T3

I M.Tech - II Semester - Regular Examinations – September 2015

**ADVANCED ROBOTICS  
(MACHINE DESIGN)**

Duration: 3 hours

Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. a) With the help of line diagram, explain basic components of a Robot system. 7 M
- b) Classify the robots based on their different configurations and discuss their applications and limitations. 7 M
2. a) A rigid body is rotated about the fixed z-axis by  $30^\circ$  followed by a translation of 2 units in the x direction and 4 units in the y direction. Find transformation matrix  ${}^A T_B$  and its inverse transformation,  ${}^B T_A$  7 M
- b) Derive an expression for transformation matrix for a velocity problem. 7 M

3. a) Figure-1 shows a planar 3-dof, 3r manipulator. We wish to move the end effector, Q, along the  $x_3$ -axis at 1.0 m/s and at the same time, keep the direction of approach, the  $x_3$ -axis, in the  $-y_0$  direction. Calculate the joint rates required to accomplish this task. Under what conditions will the joint rates approach infinity? 14 M

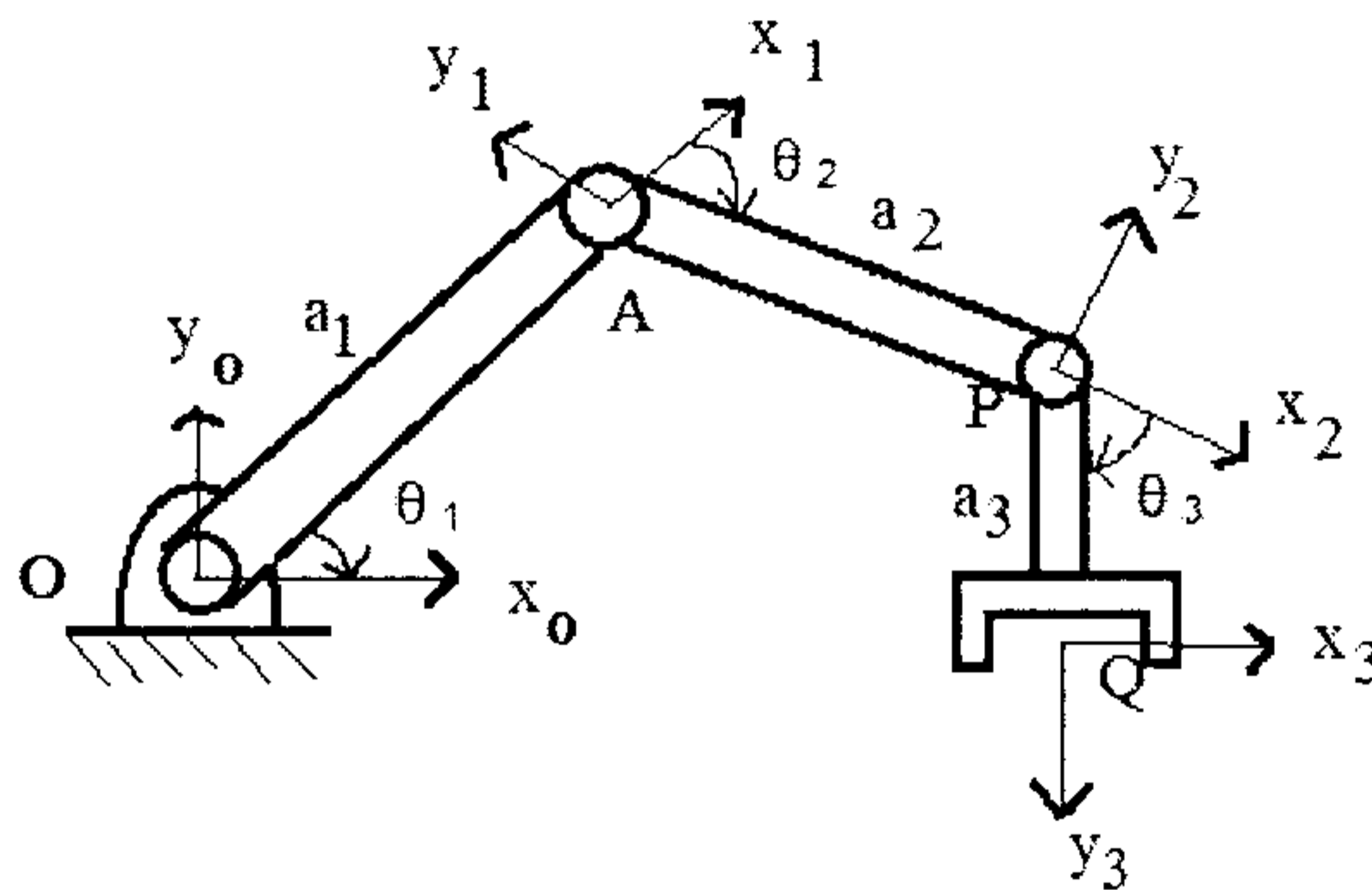


Figure-1

4. a) What are the different types of sensors used in robots? Explain the suitable sensor to measure the position of the gripper accurately. 7 M
- b) Distinguish between the force and torque sensors. 7 M
5. a) Explain the application of Lagrangian-Euler equations for a two link planar manipulator having masses  $m_1, m_2$  and lengths  $d_1, d_2$  and joint angles  $\theta_1, \theta_2$  7 M
- b) Explain static force analysis of robots. 7 M

6. a) Describe in detail about Lead through programming and Textual Programming. 7 M
- b) Calculate the parameters for a two segment linear spline with parabolic blends with acceleration in the blend region to be  $30 \text{ deg/s}^2$  and a duration of each segment as 3 seconds. The three path points for the joint are  $15^\circ$ ,  $-5^\circ$  and  $30^\circ$  and plot the trajectory. 7 M
7. a) Explain various characteristics of a Robot actuating system. 7 M
- b) Give the detailed comparison of Robot actuating system. 7 M
8. Explain the following 14 M
- a. Differential changes between frames
  - b. Relation between Jacobian and differential operator
  - c. Differential transformations of a frame.