

Code: MEMD2T3

I M.Tech-II Semester - Regular Examinations – AUGUST 2016

ADVANCED ROBOTICS
(MACHINE DESIGN)

Duration: 3 hours

Max. Marks: 70

Answer any FIVE questions. All questions carry equal marks

1.

a) How robots are classified and explain them briefly. 7 M

b) Describe the components of a robotic system. 7 M

2. Two frames, {A} and {B}, are initially coincident. Frame {B} undergoes the following four motions in sequence with respect to frame {A}:

- i. A rotation of θ about z-axis,
- ii. A translation of d along z-axis,
- iii. A translation of a along x-axis, and finally
- iv. A rotation of α about x-axis.

Determine the final homogenous transformation matrix to describe frame {B}, after the transformations, with reference to frame {A}.

14 M

3.

a) Formulate the forward kinematic model for *2-DOF RR type Planar Robot*. 7 M

b) Perform inverse kinematics and find all possible sets of θ_1 and θ_2 in a planar RR type robot with two degrees of freedom, to locate the end effector at (3,4 meters). Take the link lengths $l_1 = 4$ meters and $l_2 = 2$ meters. 7 M

4.

a) Compute the Jacobian matrix for the two link planar arm shown in Figure-1. 10 M

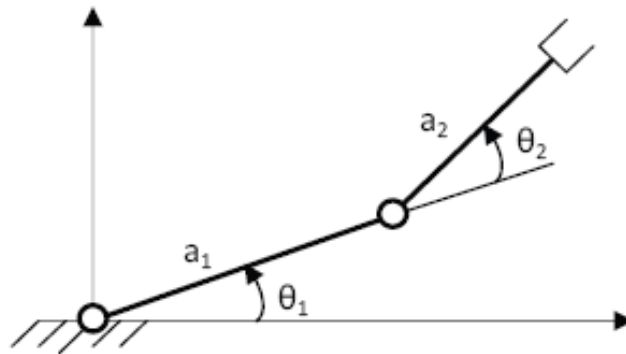


Figure-1

b) Explain the differential motions of a robot and its hand frame. 4 M

5. Using the Lagrangian method, derive the equation of motion for the two-degree of freedom robot as shown in Figure-2. The centre of mass for each link is at the center of the link. The moments of inertia are I_1 and I_2 . 14 M

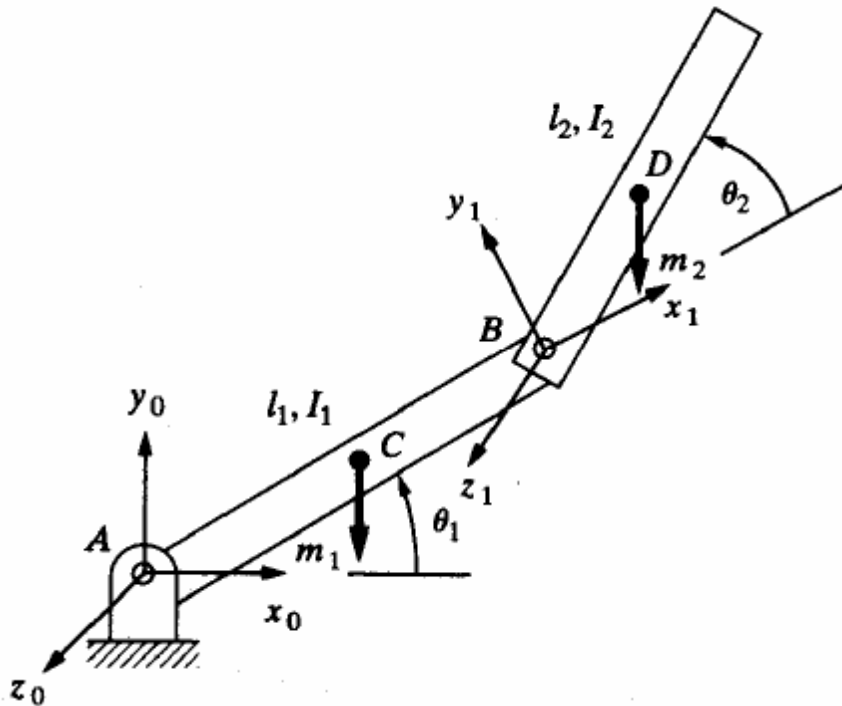


Figure – 2

6.

a) Distinguish between path and trajectory. Explain the basics of trajectory planning. 7 M

b) The second joint of a SCARA manipulator is required to move from 30° to 105° in 5 seconds. Find the cubic polynomial to generate the smooth trajectory for the joint.

7 M

7.

a) Explain the relative merits and demerits of hydraulic actuator systems, pneumatic actuator systems and electrical drive systems. 7 M

b) With the aid of a sketch, explain construction, working of stepper motor. 7 M

8.

a) With the help of sketches, explain how an encoder can be used to measure the position with accuracy? 7 M

b) With the aid of a sketch, describe briefly a strain-gauge type Force and Torque sensor. 7 M