Code No: RR411406 **Set No.1**

IV B.Tech. I Semester Regular Examinations, November -2005
ROBOTICS
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Discuss in detail about the advantages of Robotics over other form of Automation in manufacturing industry. [16]

2. What are the basic components of a robotic system? Explain the functions of each of the components with a diagram. [16]

3. Suppose 'R' represents a rotation of 90^0 about y_o followed by a rotation of 45^0 about z_1. Find the equivalent axis/angle to represent 'R'. Sketch the initial and final frames and the equivalent axis vector 'k' [16]

4. (a) Explain the different techniques for finding the Inverse kinematics for any manipulator. [8]

   (b) Derive the forward kinematics equation using the DH convention for the three link planar manipulator shown in the figure1. [8]

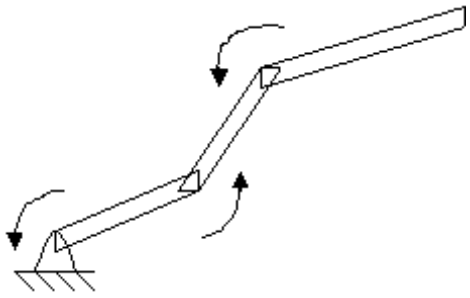

Figure 1:

5. Find the manipulator Jacobian matrix J (q) of the five axis spherical co-ordinate robot. [16]

6. Distinguish clearly between forward Newton - Euler equations and Forward Newton -Euler equations and backward Newton euler Equations, with a simple example. [16]

7. (a) List the types of manipulators employed for traveling from point to point. [4]

   (b) A single link robot with a rotary joint is motionless at $\theta_0 = 15^0$. It is desired to move the joint is a smooth manner to $\theta_f = 75^0$ in 3 seconds. Find the co-efficients of a cubic which accomplishes this motion and brings the arm to rest at the goal. [12]

8. (a) Sketch and explain the Rotary vane fluid power system used in Robot arm. [10]

   (b) List out the advantages and disadvantage of hydraulic actuators. [6]

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Code No: RR411406 **Set No.2**

IV B.Tech. I Semester Regular Examinations, November -2005
ROBOTICS
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain in brief the present industrial applications of Robots. [16]
2. Distinguish between two-point and three-point centering of robot gripper. With one application for each. [16]
3. (a) Define Translation transformation and explain how the coordinate of the vector changes. [8]
   (b) A point P (5,5) lies in a 2-D reference frame. The point has to move along the line at an angle 45^0 for a distance of 10 units. What are the coordinates of the final position of the point? [8]
4. What is a forward kinematics problem? Explain Denavit-Hartenberg convention for selecting frames of reference in robotic application. [16]
5. Find the manipulator Jacobian matrix J (q) of the five axis spherical co-ordinate robot. [16]
6. (a) Explain the Lagrange Euler's formulation for robot arm. [8]
   (b) Differentiate clearly with reference to 2- jointed manipulator of RR type and LL type. [8]
7. Trajectory planning and motion control determines the type of actuator required, explain three different systems, one with hydraulic, one with pneumatic and one with electrical actuator. Provide detailed justification. [16]
8. (a) What are encoders? With a neat sketch explain the working of an incremental encoder. [10]
   (b) Differentiate between in incremental and absolute encoders. [6]

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Code No: RR411406 **Set No.3**

IV B.Tech. I Semester Regular Examinations, November -2005
ROBOTICS
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Discuss the specific features of a Robot that are required for arc welding process and how it different from one that is used for spot welding? [16]

2. What do you understand by degrees of freedom (DOF)? How many DOFs are required to position an end-effector at any point in 3-D space? Justify. [16]

3. Suppose 'R' represents a rotation of 90^0 about y_o followed by a rotation of 45^0 about z_1. Find the equivalent axis/angle to represent 'R'. Sketch the initial and final frames and the equivalent axis vector 'k' [16]

4. (a) What is meant by symbolic Notation. Formulate DH 4x4 transformation matrix. [8]

   (b) Given a desired position and orientation of the end-effector, how many solutions are there to the inverse kinematics of the three-link planar arm shown in figure2. Use the geometric approach. [8]

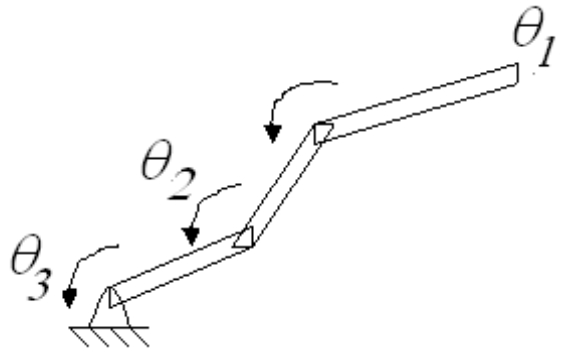

Figure 2:

5. Find the manipulator jacobian matrix J (q) of the two-axis planer articulated robot shown in figure 3. [16]

6. Establish the dynamic model of a one -axis Robot (inverted pendulum) with Lagrange-Euler formulation. [16]

7. A jointed - arm robot of configuration VVR is to move all three axes so that the first joint is rotated through 50^0 and the second joint is rotated through 90^0 and the third joint is rotated through 25^0 . Maximum speed of any of these rotational joints is 10^0/sec Ignore effects of accede rations and deceleration. [16]

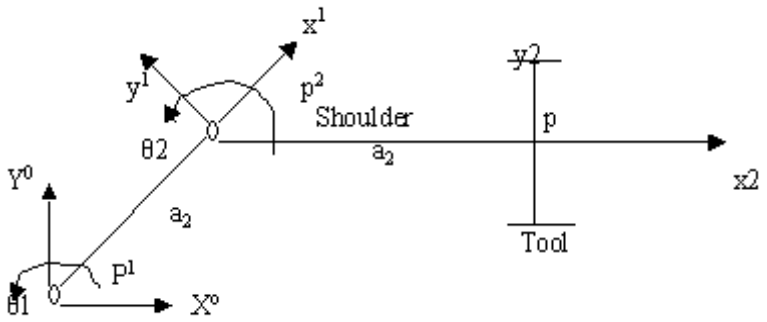

Figure 3:

(a) Determine the time required to move each joint if slew motion is used

(b) Determine the time required to move the arm to the desired position and the rotational velocity of each joint, if joint interpolated motion is used

8. Explain the different types of actuators that can be used for the robot joints. [16]

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Code No: RR411406 **Set No.4**

IV B.Tech. I Semester Regular Examinations, November -2005
ROBOTICS
(Mechatronics)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain with the neat diagram how Robot can be gainfully employed in the inspection methods of component made in large number. [16]

2. Discuss the various actuator and feed back components in detail. [16]

3. Explain the difference between Cartesian coordinate representation and Homogeneous coordinate representation with an example. [16]

4. Considering a jointed arm robot manipulator with its x, y and z axes aligned with a reference Cartesian co-ordinate frame but located at {x, y} = {3 mt, -2 mt} the end of arm of the robot is currently at {x, y, z} = {4 mt, 1 mt, 2 mt} relative to the reference co-ordinate frame. As end effector is 0.5 mt in length is attached to the end of arm is pointing vertically down. Relative to the tip of the end effector is a cube with 15 mm on a side and with its nearest corner positioned 0.5 mt in the x direction 1 mt in y direction and 0 mt in z direction from the tip of the end effector. For the above description make the sketch of work volume cell. [16]

5. Find the manipulator jacobian matrix J (q) of the two-axis planer articulated robot shown in figure4. [16]

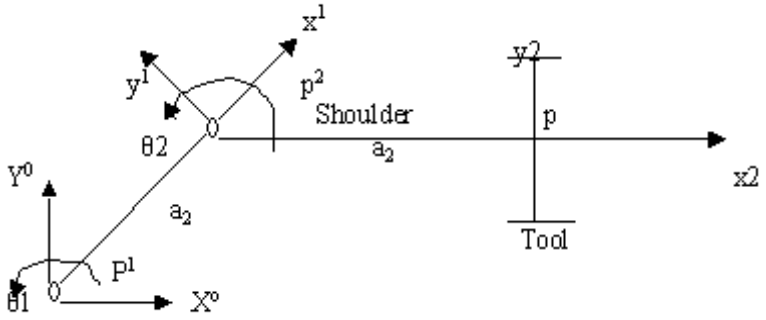

Figure 4:

6. Establish the dynamic model of a one -axis Robot (inverted pendulum) with Lagrange-Euler formulation. [16]

7. A manipulator with a single link is to rotate from $\theta\ (0) = 30^0$ to $\theta\ (2) = 100^0$ in 2 seconds. The joint velocity and acceleration are both zero at the initial and final positions. [16]

(a) Determine the co-efficients of a cubic polynomial that accomplishes the motion.

(b) Determine the co-efficients of a quartic polynomial that accomplishes the motion and

(c) Determine the co-efficients of a quintic polynomial that accomplishes the motion.

8. (a) With a neat sketch explain the construction and working of a pneumatic actuator. [10]

(b) What are the advantages of disadvantages of electrical actuators? [6]

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