Code No: RR420305 **Set No. 1**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write a detailed notes about Flexible Automation, with applications. [16]
2. Name any three types of end effectors for robots. State the advantages of each? [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. 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 five axis spherical co-ordinate robot. [16]
6. Compare the differences between the representation of angular velocity and kinetic energy of the Lagrange-Euler and Newton - Euler equations of motions in the following table. [16]

	Lagrange Euler	Newton Euler
Angular velocity		
Kinetic velocity		

7. (a) Discuss robot trajectory planning? [8]
   (b) Explain the general guidelines for planning a joint interpolated motion trajectory. [8]
8. (a) Explain the control loops using current amplifier for the robot joint motions mentioning the response equations involved. [8]
   (b) What is path planning and explain why path planning is required for a robotic system. [8]

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Code No: RR420305 **Set No. 2**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain use of Robots in the fields of welding and painting. [16]
2. With the aid of a sketch describe the mounting of a spot welding electrodes on a robot wrist. [16]
3. For the point $a_{uvw} = (6, 2, 4)^T$ perform following operations. [5+5+6]
   (a) Rotate 30^0 about the X axis, followed by translation of 6 units along Y axis.
   (b) Translate 6 units along Y axis, followed by rotation of 30^0 about X axis.
   (c) Rotate 60^0 about Z axis followed by translation of 10 units along the rotated U axis.
4. Write and explain the algorithm for deriving the forward kinematics for any manipulator based on D-H convention. [16]
5. Find the manipulator jacobian matrix J (q) of the two-axis planer articulated robot shown in figure1. [16]

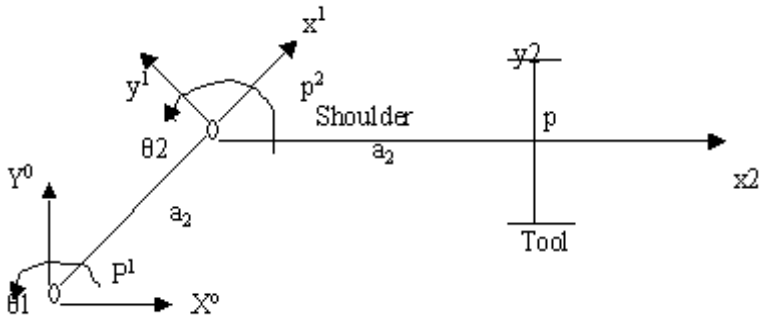

Figure 1:

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 the conditions under which a position sensor is preferred versus encoder based systems? Where are encoders placed with respect to drive system and where are position sensors placed? Can both the systems be used on the same robot? [12]

   (b) Why are absolute encoders preferred? [4]

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Code No: RR420305 **Set No. 3**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
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. Illustrate a robot gripper with [5+5+6]
   (a) cam operated
   (b) gear operated
   (c) lever (links) operated fingers

3. Define rotation transformation and explain how to represent the transformation for rotation of an angle 'θ'about x , y and z-axis. [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 figure1. [16]

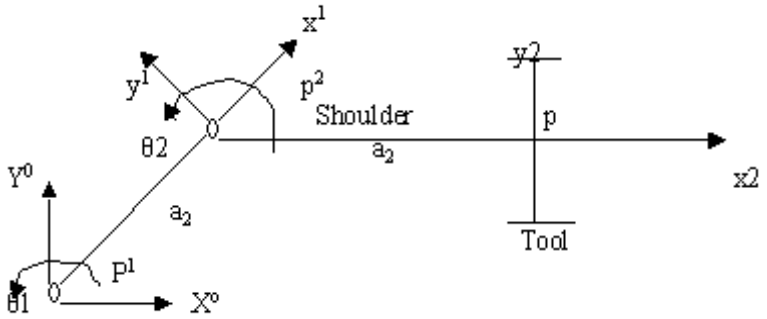

Figure 1:

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. Explain a 3-5-3 trajectory plan to represent a pick and place movement for an assembly operation. [16]

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

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Code No: RR420305 **Set No. 4**

IV B.Tech II Semester Regular Examinations, Apr/May 2006
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Why are Robots used in a flexible manufacturing cells? [8]
   (b) What advantages are derived by its use in the cell? [8]
2. Name five different types of robot end effectors. Compare and contrast the end effectors from the viewpoint of their functions. [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. Write and explain the algorithm for deriving the forward kinematics for any manipulator based on D-H convention. [16]
5. Find the manipulator jacobian matrix J (q) of the two-axis planer articulated robot shown in figure1. [16]

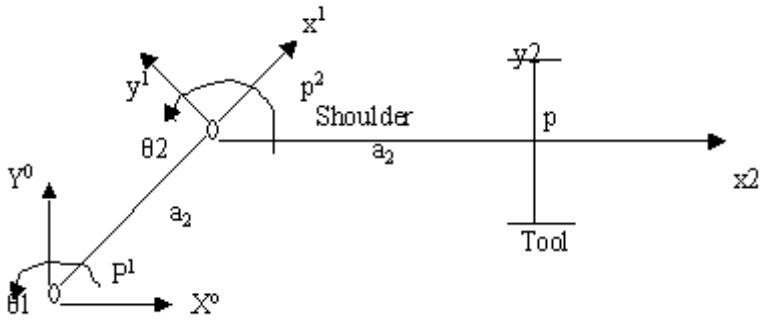

Figure 1:

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) What is path planning? Explain the need for path planning. [6]
   (b) Differentiate between path planning and trajectory planning. [4]
   (c) What are the drawbacks of incremental encoders? [6]

8. (a) Draw the figure of a hydraulic system of robot and show how the out put shaft velocity is proportional to the flow of the oil in motor-pump combination for a hydraulic system. [10]

   (b) Compare and contrast hydraulic and Electrical actuators. [6]

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