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

IV B.Tech II Semester Regular Examinations, Apr/May 2007
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Mention the various levels of Robot technology and state the different classes of Robot technology levels and their unique characteristics. [16]

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

3. (a) Briefly explain about the following. [8]
   i. Homogeneous coordinates
   ii. Homogenous Transformation.
   (b) For the point 3i+7j+5k perform the following operation :
   Translates 6 units along Y then rotate 30^0 about X. [8]

4. Perform the forward transformation for the five axis Microbot using the following data. [16]

Link	a	α	θ	d
1.	0	-90	θ_1	d_1
2.	a_2	0	θ_2	0
3.	a_3	0	θ_3	0
4.	a_4	$+90^0$	θ_4	0
5.	0	0	θ_5	d_5

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

6. Consider the cone shaped link of mass m shown in fig let Lc be the frame obtained by translating frame Lo = (x^0, y^0, Z^0) to the center of mass of the cone. Find the inertia tensor D-bar of this link about its center of mass expressed with respect to frame Lc .as shown in figure 6 [16]

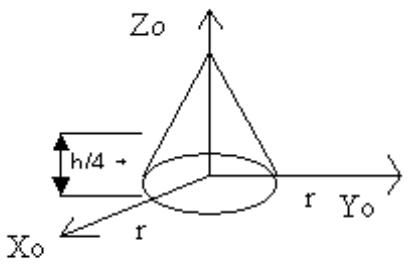

Figure 6

7. Consider a two-link robot arm and assume that each link is 1 m long. The robot arm is required to move from an initial position $(x_o, y_o) = (1.96, 0.50)$ to a final position $(x_f, y_f) = (1.00, 0.75)$. The initial and final velocity and acceleration are zero. Determine the co-efficients of a cubic polynomial at each joint to accomplish the motion. [16]

8. Under what conditions a hydraulic motor is preferred, compared to stepper or DC servomotor. Briefly explain the functioning of a hydraulic motor. [16]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech II Semester Regular Examinations, Apr/May 2007
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Explain use of Robots in the fields of welding and painting. [16]

2. What is the work envelop of a robot? Discuss its features in detail. [16]

3. (a) Briefly explain about the following. [8]
   i. Homogeneous coordinates
   ii. Homogenous Transformation.
   (b) For the point 3i+7j+5k perform the following operation :
   Translates 6 units along Y then rotate 30^0 about X. [8]

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 figure4b. [8]

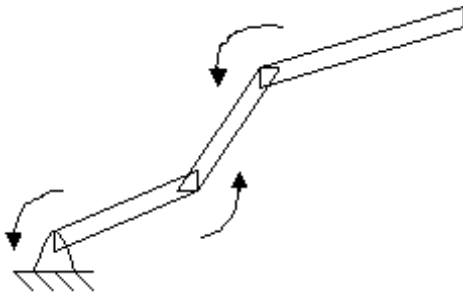

Figure 4b

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

6. In the re cursive Newton Euler equations of motion referred to its own link co ordinate frame, the matrix (iRo Ic oRi)is the inertial tensor of link i about the i^{th} co ordinate frame. Derive the relationship between the matrix and the pseudo - inertica matrix Ji of the Lagrange - Euler equations of motion. [16]

7. An automated guided vehicle has to be designed to aid visually disadvantages people. What strategy would you adopt to avoid obstacles and path planning?[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]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech II Semester Regular Examinations, Apr/May 2007
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. What is the role of a Robot in material handling systems? Discuss. [16]
2. With reference to the end effector explain in detail: [6+5+5]
   (a) mechanical fingers
   (b) specials tools
   (c) universal fingers.
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. 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. Derive the expression for joint torques for a planar R-P robotic manipulator using Lagranze-Euler formulation. [16]
7. An automated guided vehicle has to be designed to aid visually disadvantages people. What strategy would you adopt to avoid obstacles and path planning?[16]
8. (a) Explain various devices used as position sensors in robots. [8]
   (b) Discuss any one device that can be used as velocity sensor in robot. [8]

⋆ ⋆ ⋆ ⋆ ⋆

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

IV B.Tech II Semester Regular Examinations, Apr/May 2007
ROBOTICS
(Common to Mechanical Engineering and Production Engineering)
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. State some applications of Robotics in various fields including agriculture, medical and defense areas. [16]
2. How do you classify robot end-effectors? Discuss in detail. [16]
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. 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. Explain Direct and Inverse dynamics with a block diagram applied to a simple task. [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. Under what conditions a hydraulic motor is preferred, compared to stepper or DC servomotor. Briefly explain the functioning of a hydraulic motor. [16]

⋆ ⋆ ⋆ ⋆ ⋆