Code No: 07A70309 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,December 2011
ROBOTICS
Common to Mechanical Engineering, Mechatronics

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the general considerations in selecting a robot for material handling?
   (b) Discuss the robot application in pick - and - place operations. [8+8]

2. (a) Explain the principle of working of potentiometer.
   (b) At time t, the excitation voltage to a resolver is 24 V and the voltage across the two pairs of stator terminals will be $12\sqrt{3}$ V and 12 V. What is the shaft angle? [8+8]

3. Write an explain the algorithm for deriving the forward kinematics for any manipulator based on D-H convention. [16]

4. Draw and explain with an example the Composite rotations algorithm. [16]

5. Discuss suitable design of robot end-effectors to grip objects like:
   (a) Shafts
   (b) Rings
   (c) Flanges. [16]

6. (a) What are the important items to be considered in deciding the use of robots in
      i. Manufacturing operation
      ii. Hazardous operation.
   (b) What is meant by machine intelligence? What is AI? Illustrate a unified model of AI and Robotics. [8+8]

7. Using Norton - Euler forward equations, determine the joint torques or forces of a planar PR robotic Manipulator. [16]

8. (a) Using WAIT, SIGNAL and DELAY commands write a program for the press unloading task.
   (b) Using the 8 × 8 grid of a robot with one rotational axis and one linear axis, show the path taken by the robot if it is directed to move between point (2, 2) and point (7, 5) in the grid using joint interpolation. [8+8]

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Code No: 07A70309 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,December 2011
ROBOTICS
Common to Mechanical Engineering, Mechatronics

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the features of Robots in Arc welding? Explain.
   (b) What are the benefits of Robot spray painting? Explain. [8+8]

2. (a) Discuss the SPEED control commands of Robot languages.
   (b) Discuss the characteristics of Robot level languages. [8+8]

3. Find the coordinates of point $P(2,3,4)^T$ relative to the reference frame after a rotation of 45^0 about the x-axis. [16]

4. (a) Explain the working of AC servo motor.
   (b) At time t, the excitation voltage to a resolver is 24 V and the voltage across the two pairs of stator terminals will be 12 V and $12\sqrt{3}$ V. What is the shaft angle? [8+8]

5. Using Norton - Euler forward recursive equations, determine the motion parameters of the joints and the center of mass of links of a planar PR robotic Manipulator. [16]

6. Sketch any Four of the following robots indicating the joints and degrees of freedom:
   (a) Polar robot
   (b) Cylindrical robot
   (c) Cartesian robot
   (d) SCARA robot
   (e) Gantry robot
   (f) Jointed arm robot. [4+4+4+4]

7. What is remote centre compliance device? What is the lateral error and the angular error involved in inserting a peg in a hole? [4+12]

8. Consider the United States Robots Maker 110 manipulator. This is a five-axis spherical coordinate robot with a pitch-roll spherical wrist. Use the last half of the D-H algorithm to fill in the kinematic parameters for the Maker 110 in the table, consistent with the link-coordinate diagram. Indicate which parameters are the joint variables. [16]

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MAKER 110 Kinematic Parameters					
Axis	θ	d	a	α	Home
1					
1					
2					
3					
4					
5					

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Code No: 07A70309 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,December 2011
ROBOTICS
Common to Mechanical Engineering, Mechatronics

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Sketch and explain some linkage mechanisms for mechanical grippers. [16]

2. (a) Explain the kinematic equations using homogeneous transformations.
   (b) Explain the homogeneous transformations as applicable to rotation. [8+8]

3. (a) Explain the skew motion and joint interpolated motion with path control.
   (b) A jointed - arm robot of configuration RRR is to move all three axes so that the first joint is rotated through 50^0, 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/s. Ignore effects of acceleration and deceleration.
      i. Determine the time required to move each joint if skew motion is used.
      ii. Determine the time required to move the arm to the desired position and the rotational velocity of each joint, if joint - interpolation motion is used. [6+10]

4. (a) What is the difference between standard servo and feed forward servo?
   (b) What is error in the control loop and how can it be eliminated? [8+8]

5. Draw and explain the link-coordinate diagram of four-axis SCARA robot. [16]

6. A stepper motor is to be used to actuate one joint of a robot arm in a light duty pick - and - place application. The step angle of the motor is 10^0. For each pulse received from the pulse train source, the motor rotates through a distance of one step angle.
   (a) What is the resolution of the stepper motor ?
   (b) Relate this value to the definitions of control resolution, spatial resolution and accuracy. [4+12]

7. (a) Explain the application of industrial Robots in stamping - press operation.
   (b) What are the requirements of the Robot for spray painting applications? Explain. [8+8]

8. Determine the Jacobian of the 3 DOF Euler wrist and also determine the singularities of the wrist. [16]

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Code No: 07A70309 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,December 2011
ROBOTICS
Common to Mechanical Engineering, Mechatronics

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Compare the Electrical, Hydraulic and Pneumatic drives.
   (b) At time t, the excitation voltage to a resolver is 24 V and the voltage across the two pairs of stator terminals will be 17 V and -17 V. What is the shaft angle? [8+8]
2. For a planar RR manipulator, derive the Jacobian matrix and find the linear velocity and angular velocity of the end effector. [16]
3. State the important steps in Denavit-Hartenberg (D-H) convention. [16]
4. Distinguish between two-point and three-point centering of robot gripper. [16]
5. (a) Compare stepper motor and D.C motor drives for a robot.
   (b) State some advantages of hydraulic power compared with D.C electrical servos with respect to usage in robotic systems. [8+8]
6. Verify that the rotation matrices about the reference frame axes follow the required constraint equations set by orthogonality and length requirements of directional unit vectors. [16]
7. (a) Explain Branching in robot programs by considering palletizing operation.
   (b) Using the 8 × 8 grid of a robot with one rotational axis and one linear axis, show the path taken by the robot if it is directed to move between point (2, 1) and point (8, 2) in the grid using linear interpolation. [8+8]
8. (a) Discuss the single station Robotic Assembly system.
   (b) Discuss the Robotic series Assembly system. [8+8]

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