

Code :R7421002

1

IV B.Tech II Semester(R07) Regular Examinations, April 2011
ROBOTICS & AUTOMATION
 (Electronics & Instrumentation Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE questions
All questions carry equal marks

- Name the major components of a Robot system, and describe each of them in detail.
- Explain the following type of sensors used in the robots with neat sketches.
 - Magnetic sensors.
 - Laser sensors.
- Compare the pneumatic drives and hydraulic drives for robot manipulator in respect of the following factors.
 - Working fluid
 - Efficiency,
 - Operating pressure
 - Power to weight ratio
 - Stiffness
- What are the different types of grippers used in industrial robots ? Describe any four of them.
- With neat sketches explain about pure translation and pure rotation.
 - Find the transformation matrices for the following operations on the point $-5\bar{i} + 4\bar{j} + 7\bar{k}$
 - Rotate 45 degrees about z-axis and then translate 4 units along y-axis,
 - Translate 2 units along z-axis and rotate 60 degrees about y-axis.
- How does direct kinematics differ from inverse kinematics?
 - Obtain the D-H link parameters for the manipulator shown in figure 1.

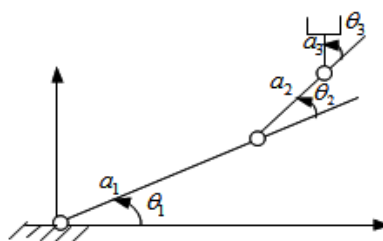


Figure 1

- It is desired to have the first joint of a six-axis robot go from initial angle of 30 degrees to a final angle of 60 degrees in 5 seconds. Using a third-order polynomial, calculate the joint angle at 1,2,3 and 4 seconds assuming the initial and final acceleration as 5 degrees/sec².
- Discuss the advantages and limitations of the use of robots in following non-industrial applications.
 - Business use of robotics,
 - Domestic applications.

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- Discuss about various applications of Robots.
 - With help of sketches describe pitch, yaw and roll motions of a robot wrist.
- With neat sketches discuss in detail about photo detector tactile sensors.
- Compare the electrical drives and hydraulic drives for robot manipulator in respect of the following factors.
 - Power
 - Efficiency,
 - Power to weight ratio,
 - Working fluid.
- Discuss about the characteristics, advantages and disadvantages of
 - Pneumatic Actuators
 - Hydraulic Actuators
- Discuss about Euler angles with neat sketches.
 - Find the transformation matrices for the following operations on the point $-3\bar{i} + 5\bar{j} + 7\bar{k}$
 - Rotate 45 degrees about x-axis and then translate 5 units along y-axis.
 - Translate 7 units along y-axis and rotate 30 degrees about x-axis.
- Find the direct kinematics equations for the two link planar arm shown in Figure. 1. Obtain the solutions for the inverse kinematics.

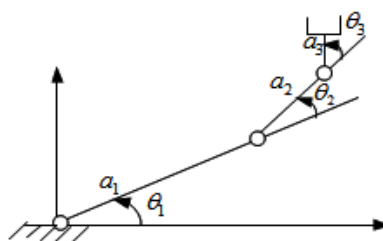


Figure 1

- It is desired to have the first joint of a six-axis robot go from initial angle of 45 degrees to a final angle of 75 degrees in 5 seconds. Using a third-order polynomial, calculate the joint at 1,2,3 and 4 seconds.
- Explain the applications of robots in loading and unloading of components and material.
 - Discuss the several ways of occurring machine interference in robot cell design.

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Answer any FIVE questions
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1. Explain about Gantry coordinate, Cylindrical coordinate and Spherical coordinate systems with neat sketches.
2. Explain the following sensors with the help of neat sketches.
 - (a) Range sensors.
 - (b) Magnetic sensors.
3. Compare the pneumatic drives and hydraulic drives for robot manipulator in respect of the following factors.
 - (a) Working fluid,
 - (b) Efficiency,
 - (c) Operating pressure,
 - (d) Power to weight ratio,
 - (e) Stiffness.
4. Describe the following types robot grippers with the help of neat sketches.
 - (a) Cam operated gripper
 - (b) Gear operated gripper
 - (c) Lever operated gripper
5. (a) Discuss about transformations.
(b) Find the transformation matrices for the following operations on the point $-6\bar{j} + 2\bar{j} + 4\bar{k}$
 - i. Rotate 45 degrees about x-axis and then translate -6 units along y-axis.
 - ii. Translate 4 units along y-axis and rotate 60 degrees about x-axis.
6. How does direct kinematics differ from inversed kinematics ? Discuss Euler angle representation for orientation.
7. (a) Discuss about third-order polynomial trajectory planning.
(b) A single cubic trajectory is given by $\theta(t) = 1 + 9t^2 - 4t^3$, and is used over a time interval from $t=0$ to $t=2$ seconds. What are the starting and final positions, velocities and accelerations?
8. (a) In which type of production, robots are preferred for loading and unloading function? Explain.
(b) With the help of simple sketch, explain robot centered work cell.

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1. With neat sketches explain about Rectangular coordinate, Cylindrical coordinate and Spherical coordinate systems.
2. With neat sketches explain the principle of working of inductive type proximity sensing.
3. Compare the electrical drives and hydraulic drives for robot manipulator in respect of the following factors.
 - (a) Power
 - (b) Efficiency,
 - (c) Power to weight ratio
 - (d) Working fluid.
4.
 - (a) Discuss about important considerations in the design of Gripper.
 - (b) Explain the working of gear operated grippers used in industrial robots with neat sketch.
5.
 - (a) Discuss about Roll, Pitch, Yaw angles
 - (b) Find the transformation matrices for the following operations on the point $-8\bar{i} + 4\bar{j} + 5\bar{k}$
 - i. Rotate 30 degrees about y-axis and then translate -2 units along z-axis,
 - ii. Translate 6 units along x-axis and rotate 45 degrees about y-axis.
6. What is inverse kinematics problem? Explain the solution to the inverse kinematics problem with an example.
7.
 - (a) Explain the differences between robot programming and traditional programming.
 - (b) A single cubic trajectory is given by $\theta(t) = 5 + 45t^2 - 20t^3$, and is used over a time interval from $t=0$ to $t=2$ seconds. What are the starting and final positions, velocities and accelerations?
8.
 - (a) What are the various applications of robots in hazardous areas ? Discuss them in detail.
 - (b) What are the two basic categories of interlocks used in robot work cell design ? Explain.
