

**IV B.Tech I Semester Supplementary Examinations, April/May 2005**  
**ROBOTICS**

( Common to Mechanical Engineering, Mechatronics and Production Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions  
 All Questions carry equal marks

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1. Explain clearly the term Automation and suggest the various applications of automation in Industry.
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.
3. Given a vector  $r_{uvw} = [6, 4, 2]^T$  with respect to the  $uvw$  coordinates system determine  $r_{xyz}$  if  $uvw$  is rotated about  $z$  axis by  $60^\circ$ .
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  $\{x, y\} = \{3 \text{ mt}, -2 \text{ mt}\}$  the end of arm of the robot is currently at  $\{x, y, z\} = \{4 \text{ mt}, 1 \text{ mt}, 2 \text{ mt}\}$  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.
5. Find the joint space singularities of the cylindrical -coordinate robot. Describe the self-motions of the manipulator at singularities if present.
6. Establish the dynamic model of a one -axis Robot (inverted pendulum) with Lagrange-Euler formulation
7. (a) List the types of manipulators employed for traveling from point to point .  
 (b) A single link robot with a rotary joint is motionless at  $\theta_0 = 15^\circ$ . It is desired to move the joint in a smooth manner to  $\theta_f = 75^\circ$  in 3 seconds. Find the co-efficients of a cubic which accomplishes this motion and brings the arm to rest at the goal.
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.  
 (b) Compare and contrast hydraulic and Electrical actuators.

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