

**BACHELOR OF TECHNOLOGY IN  
MECHANICAL ENGINEERING  
(COMPUTER INTEGRATED  
MANUFACTURING)**

**Term-End Examination**

**December, 2012**

**BME-029 : ROBOTICS**

*Time : 3 hours*

*Maximum Marks : 70*

---

**Note :** *Attempt **any seven** questions. All questions carry **equal** marks. Use of Scientific calculator is permitted.*

---

1. (a) What are the ways of classifying a robot ? 5+5  
Name two robot manufacturers and their  
robot programming languages.  
  
(b) What are the differences between stepper  
motor and DC serve motor ? Explain.
2. Explain Algebraic solution of a three link planar 10  
manipulator for inverse kinematics problem.
3. Explain Euler-Lagrange formulation based on 10  
kinetic energy.

4. What are the industrial applications of robots? **10**  
Describe four industrial functions which can be performed by robots. Do robots prevent safety problems to human.
5. The Co-ordinates of a point  $q_{abc}$  is given by  $(7,5,3)^T$  **10**  
which is rotated about the OX-axis of the reference frame OXYZ by angle of  $60^\circ$ . Determine the co-ordinates of the point  $q_{xyz}$ .
6. (a) Compare on-line and off-line programming of a robot bringing out advantages and disadvantages of each. **5+5**  
(b) Sketch a robot arm in cylindrical co-ordinates.
7. (a) Discuss the advantages and disadvantages of hydraulic actuators in robot. **5+5**  
(b) Describe the permanent magnet stepper motor.
8. (a) What are the criteria for deciding the robot for a flexible manufacturing system? **5+5**  
(b) A PTP robot with a revolute joint moving with velocity of 15 deg/sec, traverse from an initial position of  $15^\circ$  to a final position of  $75^\circ$ . Determine the position and velocity at the end of 1,2,3,4 seconds. The range of initial and final position is covered in 5 secs with a finite acceleration of 6 deg/sec<sup>2</sup>.

9. (a) What is control law ? Express the force to be applied by an actuator in form of an equation. Express closed loop dynamics in equations. What conclusions are drawn from these equations ? 5+5
- (b) What are lead through programming and walk through programming of a robot ?
10. (a) With the help of a block diagram, explain the functions of a robotic vision system and devices used in the same system. 5+5
- (b) What are the "laws of Robotics" ? Explain.
-