

Total No. of Questions : 10]

SEAT No. :

P2149

[Total No. of Pages : 3

[5254] -545

B.E. (Mechanical) (End Sem)

ROBOTICS

(Semester - II) (Elective - III) (2012 Pattern)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Figures to the right indicate full marks.
- 2) Draw neat figures wherever necessary.
- 3) Use of Scientific calculators is allowed.

Q1) a) Explain with neat sketch derivation of link transformation. [4]

b) Explain sensor selection criteria for robotic applications. [6]

OR

Q2) a) Explain the construction of Brushless DC motor with neat sketch. Transformation matrix of an object with respect to the robot base is given by [4]

$$\text{Base}_{\text{Object}} = \begin{bmatrix} 1 & 0 & 0 & 15 \\ 0 & 0 & 1 & -35 \\ 0 & -1 & 0 & 20 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

b) The gripper of the robot has its application vector parallel to X - axis of the robot base frame and the sliding vector parallel to the Y - axis of the robot base frame. Determine the 3×3 rotation matrix between the robot base and gripper; also between the object and the gripper. [6]

Q3) a) Explain with suitable examples velocity ellipse and ellipsoids. [6]

b) Explain different joints used in robots. [4]

OR

P.T.O.

- Q4) a)** Write a short note on **[6]**
 i) Jacobian
 ii) Singularities
- b) Explain with neat sketch the construction of servo grippers. **[4]**

- Q5) a)** Write down the steps involved in simulation of equations of motion for serial manipulator. **[8]**
- b) Explain dynamic model requirements of a spatial manipulator. **[8]**

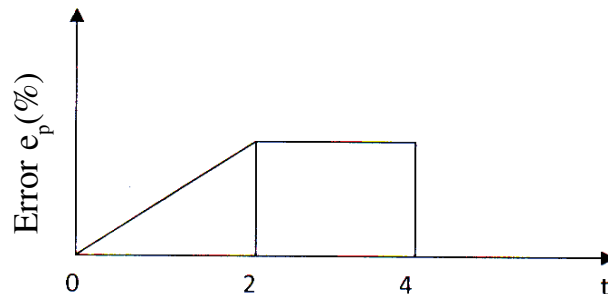
OR

- Q6) a)** Derive Lagrangian - Euler formulation for single link with rotary joint. Derive an expression for torque at joint. **[10]**
- b) What are different tools used in simulation of Robotics? **[6]**

- Q7) a)** What are general considerations in Trajectory planning. An actuated joint of a six axis Robot is to be rotated from 30° to 80° in 5 seconds. **[8]**
- b) Determine Linear, Quadratic, and Cubic trajectories for the joint. **[8]**

OR

- Q8) a)** Explain different types of controllers used in industrial robots. **[8]**
- b) What will be the PID output having $K_p = 4$, $K_i = 0.6$, $K_D = 0.5$ and $P_0 = 55\%$ and subject to error change as shown in figure. **[8]**
- i) Initially
- ii) After 4 seconds



- Q9)** a) Explain steps in Image processing and analysis. **[8]**
- b) Explain necessity and application of Artificial Intelligence for Robotic system. **[10]**

OR

- Q10)** a) Write a short note on **[10]**
- i) Linear Kalman filter
- ii) Sampling
- b) Explain various techniques of AI. **[8]**

