

Total No. of Questions : 10]

SEAT No. :

P3318

[Total No. of Pages : 3

[4660] - 219

M.E. (Mechanical) (CADM & E)

ROBOTICS

(2012 Pattern) (Elective - II)

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates:

- 1) Answers to the two sections should be written in separate answer books.
- 2) Attempt any three questions from each section.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Figures to the right indicate full marks.
- 5) Assume Suitable data, if necessary and mention it clearly.

SECTION - I

- Q1)** a) Explain in detail SCARA type of robot configuration. [8]
- b) Explain with neat sketch what type of robot configuration is suitable for the following applications [10]
- i) Sheet metal handling
 - ii) Painting

- Q2)** a) Explain role of homogeneous transformation matrices in robotics. [6]
- b) The link parameters for the three link robot configuration shown in table 1. Compute the concatenated transformation matrix for each link and also find total transformation matrix for the entire configuration from initial to final link position. [10]

Link i	α_{i-1}	a_{i-1}	d_i	θ
1	0°	0	0	45°
2	90°	5	0	0°
3	0°	10	0	0°

Table 1, Q No 2 (b)

P.T.O.

- Q3)** a) Explain the steps for implementing D-H convention for three axis articulated robot arm. [8]
- b) Determine the time required for each joint of a three axis RRR manipulator to travel the following distances using slew motion joint 1: 10° , joint 2: 30° and joint 3 : 45° . The joint 1,2 and 3 are travel at a rotational velocity of $20^\circ /s$, $15^\circ /s$ and $30^\circ /s$ respectively. [8]
- Q4)** a) What is trajectory planning and explain its role in robotics. [8]
- b) A point P (5, 5, 5) in attached to a frame (u, v, w) in subjected to the transformations but all transformations relative to the current moving frame are as follows. [8]
- i) A rotation of 45° about u-axis.
- ii) Translation of (2,-4, 1) along uvw axis.
- iii) Followed by rotation of 30° about w-axis. Find the new coordinate points of a frame.
- Q5)** a) Compare between Bug algorithm and Tangent Bug algorithm. [8]
- b) Explain Inverse Kinematics applied in robotics. [8]

SECTION - II

- Q6)** a) Using the L.E formulation used for describe the rigid body dynamics of the robot manipulator. [10]
- b) Explain the joint velocities as applied to the robot arm dynamic analysis.[8]
- Q7)** a) Explain rotary position sensors used in robot joints. [8]
- b) Explain the basic functions of robot vision system. [8]
- Q8)** a) Explain joint space scheme and Cartesian space scheme for trajectory planning. [8]
- b) A two degree of freedom planar robot is to follow a straight line between the start (3, 10) and end (8, 14) points of the motion segment. Find the joint variables for the robot if the path is divided into 10 segments. Each link is 9 cm long. [8]

- Q9) a)** Describe the following robot language commands in brief. **[8]**
- i) MOVE
 - ii) DELAY
 - iii) CLOSE
 - iv) OPEN
- b) Show the path taken by the Cartesian co-ordinate robot. If it is directed to move across 9×9 square grid to move between the following sets of points in the grid using linear interpolation. **[8]**
- i) point (1, 1) and point (6, 6)
 - ii) point (2, 1) and point (8, 2)
 - iii) point (2, 2) and point (8, 6)
- Q10)a)** Write short notes on artificial intelligence **[6]**
- b) Future applications of robots **[5]**
 - c) Use of inductive and Resistive sensors in robots **[5]**

