

Total No. of Questions : 12]

SEAT No. :

**P1064**

**[4659]-68**

[Total No. of Pages : 3

**B.E. (Electrical)**

**a : ROBOTICS AND AUTOMATION**

**(2008 Course) (Elective - I) (Semester - I)**

*Time : 3Hours]*

*[Max. Marks :100*

*Instructions to the candidates:*

- 1) *Answer three questions from Section-I and three questions from Section-II.*
- 2) *Answers to the two sections should be written in separate books.*
- 3) *Neat diagrams must be drawn wherever necessary.*
- 4) *Figures to the right indicate full marks.*
- 5) *Your answers will be valued as a whole.*
- 6) *Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables in allowed.*
- 7) *Assume suitable data, if necessary.*

**SECTION-I**

- Q1)** a) Compare fixed, flexible and programmable automation. [8]  
b) Explain laws of Robotics. [8]

OR

- Q2)** a) Explain different methods for rotary to linear motion conversion. [8]  
b) Explain the following terms: [8]  
i) Spatial resolution  
ii) Compliance  
iii) Work Envelope  
iv) Roll, Yaw & Pitch

- Q3)** a) With the help of a neat diagram, explain following types of robots: [8]  
i) Cartesian Robot  
ii) SCARA Robot  
b) Explain different types of grippers used in robot manipulator. [8]

OR

**P.T.O.**

**Q4) a)** Explain different types of electrical drives used in robots with their comparative analysis. [8]

b) Explain selection criteria of actuators for robot design. [8]

**Q5) a)** Explain the concept of homogeneous transformation matrix. [10]

b) A point P in space is defined as  $P = [2 \ 3 \ 1]$  relative to frame B which is coincident with frame A. Apply the following transformations to frame B and hence find coordinates of point P with respect to frame A. [8]

i) Rotate  $30^\circ$  about Z-axis.

ii) Translate (2) units along new X-axis and (-3) units along new Y-axis.

iii) Rotate  $60^\circ$  about new X-Axis.

OR

**Q6) a)** Explain the concept of hand matrix with the effect of pre and post multiplication of a hand matrix by basic homogeneous matrix. [9]

b) Explain different Euler angle systems used in Robotics. [9]

### SECTION-II

**Q7) a)** Explain rules for establishing coordinate frames at different joints for D-H representation. [8]

b) The link parameter table of a  $\theta$  - R manipulator, working in a horizontal plane with its  $\theta$  - axis parallel to the plane of paper, is given as - [10]

Joint	$\theta$	d	a	$\alpha$
1	$\theta_1$	$d_1$	0	$90^\circ$
2	0	R	0	0

$\theta_1$  - Rotary joint variable

R - Prismatic joint variable

i) Draw the diagram showing link coordinate system and robot manipulator.

ii) Derive hand matrix of the manipulator.

OR

- Q8) a)** Explain following methods for solution of inverse kinematics- [10]  
 i) Geometric Method.  
 ii) Direct Method.
- b) Draw a neat diagram of 'PUMA Robot' explaining the degrees of freedom. Also show all the coordinate frames attached to the robot. [8]

- Q9) a)** Explain Lagrangian analysis for deriving dynamic equations for a single revolute joint. [8]
- b) Explain manipulator Jacobean, inverse Jacobean and singularities in Jacobean analysis. [8]

OR

- Q10)a)** Explain the method of Resolved Motion Position Control (RMPC) for robot motion. [10]
- b) Find the effect of a differential rotation of 0.05 radians about X-axis followed by a differential translation of [0.2 0.1 0] on a frame [6]

$$T = \begin{bmatrix} 0 & 0 & 1 & 5 \\ 1 & 0 & 0 & 3 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- Q11)a)** Write a note on - [8]  
 i) Teach Pendant  
 ii) Online and Offline Programming
- b) Explain how a robot can be used for part sorting application. [8]

OR

- Q12)a)** Write a note on robot specific languages. [8]
- b) Explain 'Spray Painting Robot' with details of selection criteria, selection of drives and actuators, methods of control and peripheral devices used. [8]

EEE